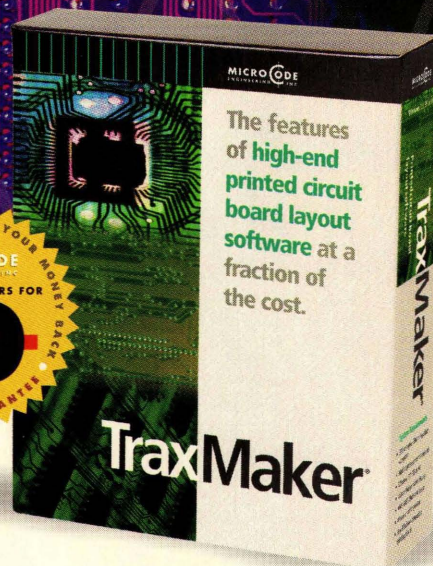
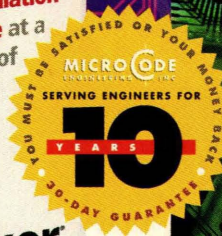
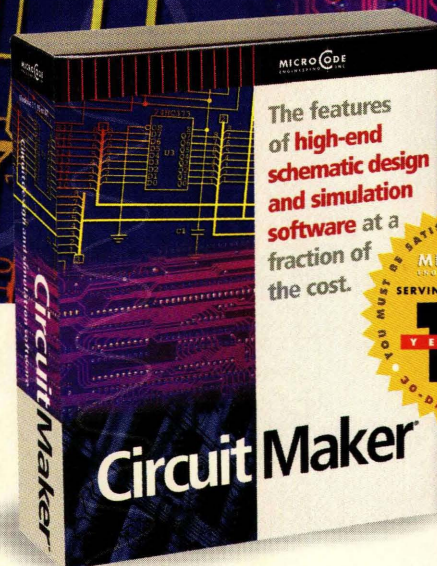


High-end features. Low-end price.

\$299

CircuitMaker 6:
Schematic design
and simulation
software



\$299

TraxMaker 3:
Printed circuit
board layout
software

CircuitMaker Version 6 and TraxMaker Version 3 give you the features of professional, high-end software at a fraction of the cost. Plus, with exceptional ease-of-use you'll spend less time learning to use the software and more time designing. Both applications are compatible with your existing software, and feature outstanding technical support. Call now for your free functional demo.

CircuitMaker 6 is a powerful schematic design and simulation program featuring:

- Professional schematic features including printout borders, title block and barred pin names
- Symbol editor and Macro feature for custom devices
- Fast, accurate SPICE3f5/XSPICE-based simulation
- Complete array of analysis types, including Fourier, AC, DC, Parameter sweep, Transient and more
- Virtual instruments including a digital oscilloscope, multimeter, Bode plotter, curve tracer and more
- Extensive library of over 4,000 models
- Tight integration with TraxMaker® for quick PCB layout
- Output PCB netlists in Protel®, Tango® and TraxMaker® formats for use in a variety of PCB layout programs
- Windows 3.1, 95 and NT

TraxMaker 3 is a powerful printed circuit board layout program featuring:

- Over 2,000 component footprints in a fully-documented, indexed library. Documentation shows footprints actual size
- Built-in autorouter and Design Rules Check
- Supports up to 6 signal layers plus power and ground planes, silk screen overlays and solder and paste masks
- Board sizes up to 32" x 32", with no pin limitations
- Intelligent manual routing with unroute capabilities
- Import any PCB netlist in CircuitMaker®, Protel® or Tango® format
- Output RS274X Gerber files, Excellon N/C drill files and Bill of Materials
- Print to any Windows-compatible printer or plotter
- Windows 3.1, 95 and NT

MICROCODE ENGINEERING INC For free demo software, or to order, call **1-800-419-4242**
927 West Center Street • Orem, UT 84057 • Phone (801) 226-4470 • Fax (801) 226-6532 • www.microcode.com

©1998 MicroCode Engineering, Inc. All rights reserved. CircuitMaker, TraxMaker, SimCode and MicroCode are registered trademarks of MicroCode Engineering, Inc. All other brand and product names are trademarks or registered trademarks of their respective companies.
CIRCLE 133 ON FREE INFORMATION CARD

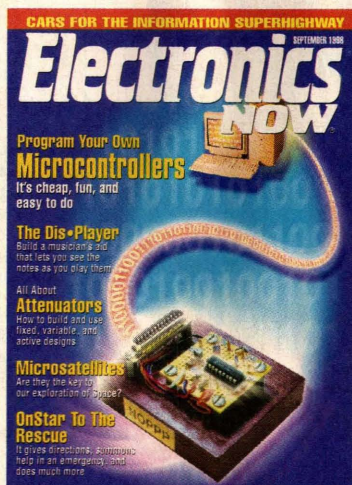
CONTENTS

SEPTEMBER 1998

ON THE COVER

35 BURN YOUR OWN MICROCONTROLLERS

As if you did not already know it, a quick look at the pages of this or any other electronics magazine will reveal that microcontrollers are at the heart of many projects and products these days. The reason is simple: One microcontroller can replace handfuls of active and passive components and do their job better and more economically. However, they do present one problem—they need to be programmed to do their job. Actually, that is no problem at all as this month's featured project will prove. Called the "No Parts" PIC Programmer, it is possibly the simplest and easiest solution to programming some of the most popular microprocessors on the market. — *Michael A. Covington*



TECHNOLOGY

15 PROTOTYPE



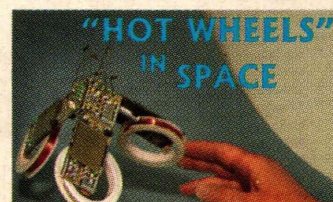
Cars for the asphalt and information superhighway, the origin of water, semiconductor breakthroughs, and more.

44 ALL ABOUT ATTENUATORS

Learn about fixed, variable, and passive designs, and how you can build and use them.

— *Ron Tipton*

49 "HOT WHEELS" IN SPACE



Are a new breed of tiny microsatellites the key to the next step in our exploration of Space? — *Douglas Page*

61 ONSTAR TO THE RESCUE

General Motors' OnStar—and similar systems—can be a lifeline for drivers when trouble strikes on the road. — *Bill Siuru*

As a service to readers, ELECTRONICS NOW publishes available plans or information relating to newsworthy products, techniques and scientific and technological developments. Because of possible variances in the quality and condition of materials and workmanship used by readers, ELECTRONICS NOW disclaims any responsibility for the safe and proper functioning of reader-built projects based upon or from plans or information published in this magazine.

Since some of the equipment and circuitry in ELECTRONICS NOW may relate to or be covered by U.S. patents, ELECTRONICS NOW disclaims any liability for the infringement of such patents by the making, using, or selling of any such equipment or circuitry, and suggests that anyone interested in such projects consult a patent attorney.

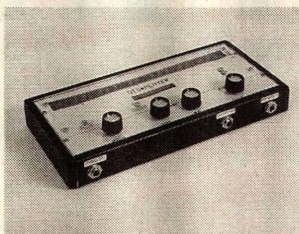
ELECTRONICS NOW, (ISSN 1067-9294) September 1998. Published monthly by Gernsback Publications, Inc., 500 Bi-County Boulevard, Farmingdale, NY 11735-3931. Periodicals Postage paid at Farmingdale, NY and additional mailing offices. Canada Post IPM Agreement No. 334103, authorized at Mississauga, Canada. One-year subscription rate U.S.A. and possessions \$24.99, Canada \$33.15 (includes G.S.T. Canadian Goods and Services Tax, Registration No. R125166280), all other countries \$33.99. All subscription orders payable in U.S.A. funds only, via international postal money order or check drawn on a U.S.A. bank. Single copies \$4.99. © 1998 by Gernsback Publications, Inc. All rights reserved. Printed in U.S.A.

POSTMASTER: Please send address changes to ELECTRONICS NOW, Subscription Dept., Box 55115, Boulder, CO 80328-5115.

A stamped self-address envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

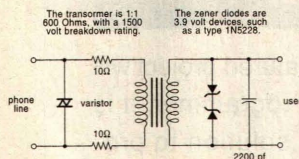
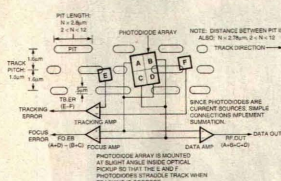
BUILD THIS

- 51 BUILD THE DIS•PLAYER**
This valuable musician's aid lets you see musical pitches as you play them. It also makes learning to play keyless instruments like the violin or trombone much easier. — *Fred Nachbaur*



DEPARTMENTS

- 14 EQUIPMENT REPORT**
IBM Home Director home-automation starter kit.
- 22 COMPUTER CONNECTIONS**
Generating random numbers. — *Jeff Holtzman*
- 25 SERVICE CLINIC**
Troubleshooting CD-player start-up problems. — *Sam Goldwasser*
- 63 TECH MUSINGS**
"Free Energy," capacitor bounceback, DAA telephone interfaces, and more. — *Don Lancaster*



AND MORE

- | | |
|------------------------|-------------------------------------|
| 4 EDITORIAL | 33 NEW LITERATURE |
| 6 Q&A | 106 ADVERTISING INDEX |
| 12 LETTERS | 106 ADVERTISING SALES OFFICE |
| 31 NEW PRODUCTS | |

Electronics NOW®

Hugo Gernsback (1884-1967) founder

LARRY STECKLER, EHF, CET,
Editor-in-chief and publisher
ADRIA COREN, Vice-President
KEN COREN, Vice-President

EDITORIAL DEPARTMENT
CARL LARON, editor
JOSEPH J. SUDA, technical editor
JULIAN S. MARTIN, associate editor
EVELYN ROSE, assistant editor
TERI SCADUTO, assistant editor
MICHAEL A. COVINGTON, N4TMI
contributing editor
SAM GOLDWASSER, service editor
JEFFREY K. HOLTZMAN,
computer editor
FRANKLIN J. MILLER,
audio editor
DON LANCASTER,
contributing editor
DEBBIE CYBULA, editorial assistant

ART DEPARTMENT
ANDRE DUZANT, art director
RUSSELL C. TRUELSON, illustrator

PRODUCTION DEPARTMENT
RUBY M. YEE, production director
KATHRYN R. CAMPBELL,
production assistant
KEN COREN,
desktop production director
MELISSA GIORDANO, desktop production

CIRCULATION DEPARTMENT
THERESA LOMBARDO,
circulation manager
GINA GALLO,
circulation assistant

REPRINT DEPARTMENT
CHRISTINA M. ESTRADA, reprint bookstore

Typography by Mates Graphics

Electronics Now is indexed in *Applied Science & Technology Index*, and *Readers Guide to Periodical Literature*, *Academic Abstracts*, and *Magazine Article Summaries*.

Microfilm & Microfiche editions are available. Contact reprint bookstore for details.

Advertising Sales Offices listed on page 106.

Electronics Now Executive and Administrative Offices
1-516-293-3000.

Subscriber Customer Service:
1-800-999-7139.
7:00 AM-6:00 PM Monday-Friday MST

VISIT US ON THE INTERNET AT:
www.gernsback.com



Audit Bureau
of Circulations
Member

We're *the* shop for home shops.

39.99
3-amp regulated power supply powers DC devices from home AC. #22-504

1.99
Durable project box with aluminum and plastic lid. #270-1801

49.99
Auto-ranging digital multimeter. Simple push-button and slide-switch controls. #22-163

19.99
Soldering work station has dual-powered iron—just flip a switch to go from 20W to 40W. #64-2184

5.99
6-piece, precision anti-static screwdriver set. Durable alloy steel shafts. #64-1963

29.99
Pocket-size torch kit. Produces 5000°F in an adjustable pinpoint flame. #64-2165

9.99
Ball-bearing type 12VDC blower fan. 2,600RPM, 180mA. #273-260

2.29
Multicolor heat-shrink tubing. Red, white, blue and clear. Pkg. of 7. #278-1610

Solutions for all your projects and repairs.

There's a RadioShack in your neighborhood with the tools, parts and accessories to complete virtually any small electronics project or repair. You'll find the hottest gear for everything from making simple repairs and testing circuits to building speaker systems and designing your own electronic devices. Even hard-to-find parts and accessories that might not be on our shelves are available for fast delivery direct to your door—just ask a store associate about RadioShack Unlimited. For our store nearest you, call 1-800-THE SHACK (1-800-843-7422).



RadioShack®
You've got questions. We've got answers.®

Prices apply at participating RadioShack stores and dealers. Independent RadioShack dealers and franchisees may not be participating in this ad or stock or special-order every item advertised.

CIRCLE 78 ON FREE INFORMATION CARD

Accredited B.S. Degree in Computers or Electronics

by studying at Home

Grantham College of Engineering
offers 3 distance education programs:

- B.S.E.T. emphasis in Electronics
- B.S.E.T. emphasis in Computers
- B.S. in Computer Science

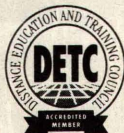
NEW - Electronics Workbench Professional 5.0
included in our B.S.E.T. curriculums
- Approved by more than 200 Companies,
VA and Dantes, (tuition assistance avail.)

For your free catalog of our programs dial
1-800-955-2527

<http://www.grantham.edu>

GCE

*Your first step
to help yourself
better your future!*



Grantham College of Engineering
34641 Grantham College Road
Slidell, LA 70460-6815

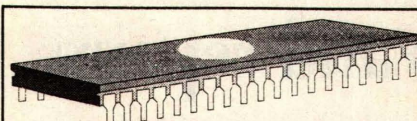
ANTIQUE RADIO CLASSIFIED

Free Sample!

Antique Radio's
Largest Circulation Monthly.
Articles, Ads & Classifieds.



6-Month Trial: \$20.95. 1-Yr: \$40.95 (\$57.95-1st Class).
A.R.C., P.O. Box 802-L21, Carlisle, MA 01741
Phone: (978) 371-0512 VISA/MC Fax: (978) 371-7129



CABLE CONVERTER DIAGNOSTIC TEST CHIP

LOADS OF ACTIVATION OF CABLE CONVERTER

**WE STOCK A COMPLETE LINE OF CHIPS, TOOLS,
WIRELESS QUICK INSTALL TEST BOARDS AND
DIAGNOSTIC CUBES FOR ALL CONVERTERS!**

***** ANYONE IMPLYING ILLEGAL USE WILL BE ***
DENIED SALE. WE SELL PRODUCTS ONLY!! TO
TECHNICIANS OR CABLE REPAIR FACILITIES!!**

**#1 IN CUSTOMER SERVICE & TECH. SUPPORT!
*ALL ORDERS SHIP WITHIN 24HRS, UPS/ FED-X.
*PRIORITY NEXT DAY SHIPPING AVAILABLE!
*SALE- BUY 6 TEST BOARDS AND GET 2 FREE.
*MONDAY THRU FRIDAY 8AM - 7PM EST.
*DEALERS WELCOME * ALL PRODUCTS GUAR!!**



COMMUNICATIONS INC.
ORDERS/CATALOG 1-800-GO-CABLE
TECHNICAL SUPPORT DEPT. 717-620-4363 EST. 1976

EDITORIAL

Glad I Asked!

Putting together a magazine like **Electronics Now** is a tough job. It is made harder by the fact that the technology that we are writing about is always changing, as are the needs and interests of our audience. To do the best job possible, I felt I had to get a better handle on what our readers wanted and expected from this magazine. That was the reason behind my July 1998 Editorial ("Who Are You? What Do You Want?").

I expected (hoped for?) at least a few responses. What I received has exceeded my wildest expectations. My e-mail and regular mail boxes have been overflowing for days, and the letters keep pouring in. So you can see for yourself what your fellow readers are thinking, we've reprinted a few of the letters in this month's "Letters" column. Some more will follow in future issues.

So, what have I learned? For one thing, our readership is a very varied bunch. That said, there were a few traits most of you share.

For example, even if you never have built one, just about all of you enjoy our projects. One common request was for a few more simple projects for those without the time or experience to tackle the big ones. Without revealing too much, I'll just say that we are working on a way to do just that, without eliminating our more sophisticated circuits.

"Service Clinic," and its new author, Sam Goldwasser, received an almost universal thumbs up. The same is true of "Tech Musings," even if you don't always agree with some of Don Lancaster's views.

Most of you like the articles on new and coming technology. Most, though not all, liked the new "Prototype" section. Just about everyone liked the "Q&A" column. One common request was a little more coverage of basic electronics; it is on the way.

On computers, the majority want, or at least would not mind, coverage of computer hardware and circuits. One common request here was for interface circuits or circuits that let you use your computer as a test instrument. On the other hand, most who expressed a preference asked that we do not delve into computer software or usage, unless it dealt expressly with electronics. On that last point, let me put any remaining fears to rest: This is **ELECTRONICS Now**, and the core of our coverage will always remain centered on electronics, not computers.

One thing did bother me, however. Many of the letters began by thanking me for the invitation to write. The thing is, your input has always been welcome and needed. Sure, we love to hear what we are doing right, but we also need to know what we are doing wrong. And an occasional letter to let us know you are still out there and paying attention is always nice. Don't be bashful, and don't be a stranger!

Carl Laron

Carl Laron
Editor

MCM ELECTRONICS®

The Source For All Of Your
Electronics Needs

When ordering, please
provide this code:

► SOURCE CODE: ENS50

Prices Effective Aug. 4,
through Sept. 30, 1998

For over 20 years, MCM has been the leading supplier to the electronics service industry. Huge inventory, rapid delivery and competitive prices have made MCM the choice for:

- Hobbyists
- Service Technicians
- Educators
- Installers

Discover the MCM difference, call today for your free catalog.



Rechargeable Screwdriver
Handle can be folded for pistol grip type use. Reversible, six torque settings. Accepts standard 1/4" hex bits. Includes slotted and Philips bits, AC charger and two battery packs.

Order # 22-1710 Reg. \$35.95

\$22.50



MCM AUDIO SELECT™

8" Polypropylene Woofer
Rubber surround provides tight punchy low frequencies and high durability. Poly cone provides immunity to humidity, making this ideal for automotive applications. Power capacity 70/100W RMS/peak, frequency response 30Hz~3.5KHz, 1" voice coil, 18 oz. magnet. 8ohm.

Order # 55-1190 Reg. \$13.50

\$9.00

Call for complete
ordering information



**FREE
Catalog!**

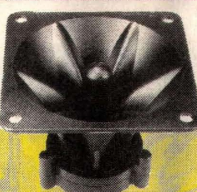
1-800-543-4330

www.mcmelectronics.com

Hours: M-F 7 a.m.-9 p.m., Sat. 9 a.m.-6 p.m., EST.

**Same Day
Shipping!**

In stock orders
received by 5:00 p.m.
(YOUR TIME), are
shipped the same day.



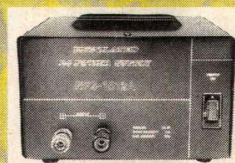
MOTOROLA

Piezo Horn Tweeter

Provides excellent transient response with low harmonic distortion. Efficient piezo design ignores low frequencies eliminating the need for a crossover. Impedance is over 1000ohm at 1KHz and over 20ohm at 40KHz. Frequency response 3~30KHz. Dimensions: 2 1/4" (H) x 2 1/4" (W) x 3" (D).

Order # 53-070 Reg. \$5.99

\$3.50



TENMA®

15A Regulated Power Supply

Provides regulated 13.8VDC output at 15 amps duty cycle (one minute on, three minutes off). Heavy duty heat sinks assure cool reliable operation. Dimensions: 17 1/2" (W) x 10" (D) x 5" (H).

Order # 72-810 Reg. \$94.25

\$59.25



TENMA®

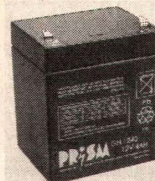
DMM W/Logic

Function

3 1/2 digit DMM measures AC/DC voltage from 200mV~600V, resistance to 2000Mohm, capacitance to 20pF, transistor h_{FE} gain and audible continuity test. Requires 9V battery (#290-080) not included. Dimensions: 2 1/2" (W) x 5 3/4" (H) x 1 1/2" (D).

Order # 72-4025 Reg. \$65.95

\$39.95



12V, 4Ah

Sealed Lead Acid Battery

Ideal for most 12VDC and battery backup applications including alarm panels. Dimensions: 2.75" x 3.65" x 4.02". Weight 3.96 lbs. Connections via .187" tabs.

Order # 29-1910 Reg. \$19.95

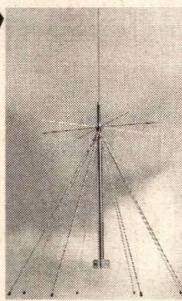
\$14.95

**Discone
Scanner/Ham
Antenna**

Versatile antenna provides continuous receive coverage from 25MHz~1300MHz. It will also transmit on the 6M, 2M, 70cm, 33cm and 23cm Ham bands, with a maximum

power rating of 200W. Antenna impedance is 50ohm and is terminated with "N" type female connector. Overall length 67".

Order # 111-2535 (ea.) \$69.95



**25~2000MHz
Test Receiver**

Sweeps the entire 25~2000MHz band and locks automatically onto any transmitted signal. Radio and television broadcasts are automatically ignored. Scans entire range in 5 seconds. FM deviation can be set at 5KHz or 50KHz. Detachable

antenna utilizes BNC type connector. Requires four "AA" type batteries (#291-030), not included. Dimensions 2 1/2" (W) x 1 1/4" (D) x 4 1/2" (H).

Order # 111-2525 (ea.) \$299.00



MCM ELECTRONICS®

650 CONGRESS PARK DR.
CENTERVILLE, OH 45459

A PREMIER FARNELL Company

SOURCE CODE: ENS50

CIRCLE 327 ON FREE INFORMATION CARD

September 1998, Electronics Now

Q & A

READERS' QUESTIONS, EDITORS' ANSWERS

Control Via PC Parallel Port

Q Could you explain how to turn a 12-volt DC relay on for 10 seconds, then off for 20 seconds, and repeat this cycle 1000 times, using a PC programmed in BASIC? The relay coil pulls about 250 mA. Ideally, I would like to be able to control three or four relays from a BASIC program. — L. H. B., Burton, MI

Q I want to write an automatic control program for a PC and send the input and output signals through the serial port or parallel port. Could you give me complete information about the serial and parallel ports? — Y. S. X., Trenton, NJ

A PC parallel ports (printer ports) are extremely handy. Each port provides eight data lines plus several control lines; the whole thing is very similar to the bus of an 8-bit microprocessor, so it's easy to interface to digital ICs and other circuitry.

Taking the first question first, you can control up to eight relays with the data lines of a parallel port using the circuit shown in Fig. 1. The relay coils are controlled by IRF510 power switching transistors driven by the data from the PC. You'll need a separate source of 12 volts unless you're sure your PC can spare 250 mA for each relay coil; in that case, you can take 12 volts from a disk-drive power connector.

The program is shown in Listing 1. It retrieves the port address of printer port LPT1 and then transmits data directly to the port, bypassing the operating system in order to ignore printer status signals ("ready," "out of paper," and the like). If you want to use port LPT2, change the PEEK functions so that they look at locations 10 and 11 instead of 8 and 9 respectively.

To count seconds, the program uses a simple trick. The BASIC function TIME\$ gives the time of day in hours,

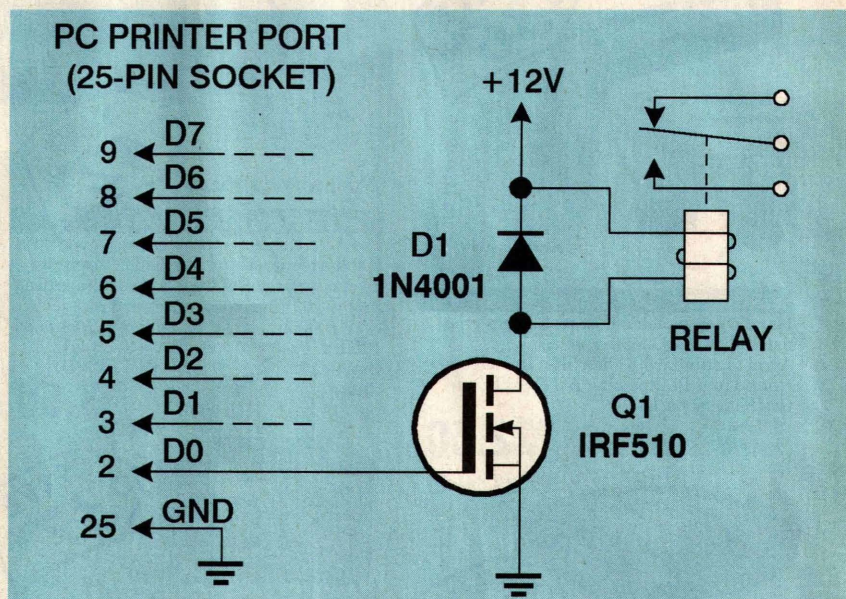


FIG. 1—EACH DATA BIT of a PC's parallel port can be used to control a relay using this simple interface circuit.

minutes, and seconds. The value of TIME\$ therefore changes exactly once per second, and when it has changed ten times, ten seconds have elapsed.

The sample program controls only one relay connected to data line D0. To control multiple relays independently of each other, use the statement

OUT p, INP(p) OR 2^N

to turn relay number N on, or

OUT p, INP(p) AND NOT 2^N

to turn relay N off, leaving the other relays unchanged. Here N ranges from 0 to 7.

You can also use the parallel port for input, as described in this column in October 1996. The definitive handbook on unconventional uses of parallel ports is *Parallel Port Complete*, by Jan Axelson, available through bookstores and by direct mail from Lakeview Research, Madison, WI 53704; Web: www.lvr.com. This is an easy-to-understand book full

LISTING 1

```
100 ' Get port address of LPT1
110 DEF SEG = &H40
120 P = PEEK(8) + 256 * PEEK(9)
130 ' Repeat 1000 times...
140 FOR I = 1 TO 1000
150 ' Turn D0 on
160 OUT P, 1
170 ' Wait 10 seconds
180 FOR J = 1 TO 10
190 TS = TIME$
200 WHILE TS = TIME$: WEND
210 NEXT J
220 ' Turn D0 off
230 OUT P, 0
240 ' Wait 20 seconds
250 FOR J = 1 TO 20
260 TS = TIME$
270 WHILE TS = TIME$: WEND
280 NEXT J
290 ' End of loop
300 NEXT I
```

of practical circuits as well as valuable reference information. The companion volume, *Serial Port Complete*, will also be available by the time you read this.

One Button At A Time

Q I am looking for a solid-state circuit that will perform the same function as a multi-position interlocking pushbutton switch, i.e., pressing any button momentarily will turn on one output while turning off all the others. It needs to be flexible as to the number of positions and each position must be capable of driving a small 12-volt relay. — C. B., Sebastian, FL

A That function would normally be implemented as part of the keypad-scanning routine of a microcontroller. That is, when you make a selection by pressing a button on your stereo or digital car radio, its microprocessor is running a program that responds to the switch closure by selecting one choice and clearing all the others.

If you want to do it with off-the-shelf ICs, Fig. 2 shows one possibility. That circuit uses a 74HC273 octal flip-flop as an 8-bit memory. Whenever you press a button and then release it, the contents of the data lines are stored in the memory. Only one button will be pressed, of course, so only one output goes high. (If you press two buttons, the one that is

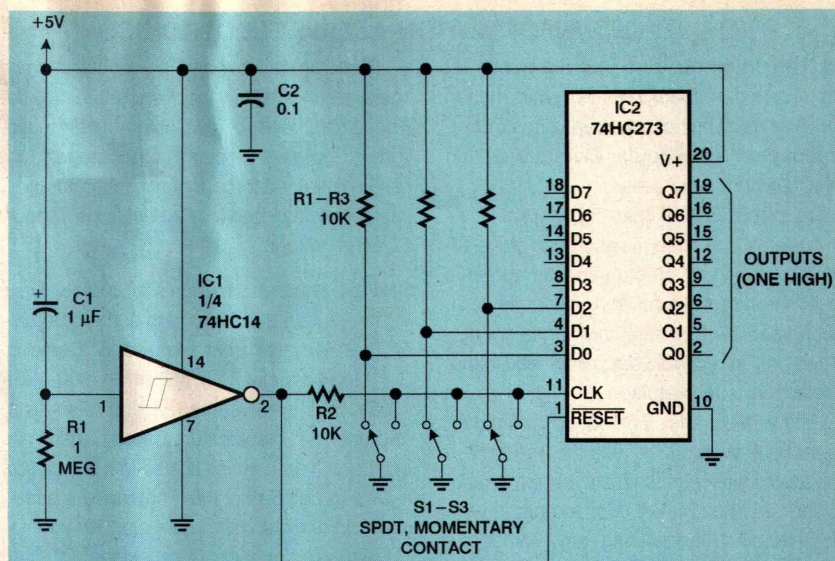


FIG. 2—THIS CIRCUIT SIMULATES the action of a multi-position interlocking pushbutton switch. The heart of the circuit is IC2, which “remembers” which switch was most recently closed.

released last will win out.) The outputs can drive relays just as in Fig. 1. If you need more than 8 outputs, use additional 273s with the RESET and CLK lines tied together.

The SPDT switches solve a pesky timing problem. Data is stored in the memo-

ry at the instant that you release the button, disconnecting CLK from ground. At that moment, the data input must still be valid. The switch takes care of this because it doesn’t make contact in one position until about a millisecond after it releases contact in the other position.

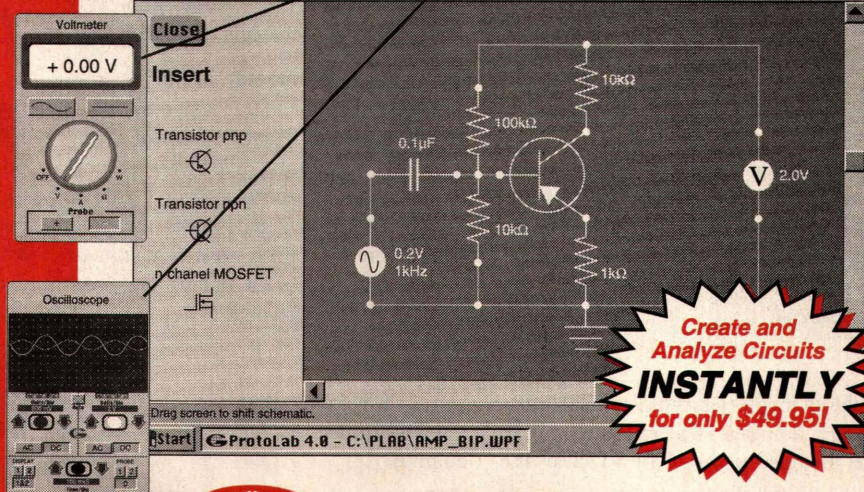
ProtoLab 4.0 YOUR NEXT GREAT DESIGN STARTS HERE!

Easy-to-use circuit simulation package from the leader in electronic prototyping.

• Designed for use with Windows®95

• Design circuits instantly while choosing from a complete list of active and passive components

• Analyze circuits using built-in test instruments.



GLOBAL SPECIALTIES
SOFTWARE

INNOVATIVE PRODUCTS. UNSURPASSED QUALITY.
1-800-572-1028 • For a demonstration, visit:
www.globalspecialties.com

Windows®95 is a U.S. registered trademark of Microsoft Corporation.

September 1998, Electronics Now

HOW TO GET INFORMATION ABOUT ELECTRONICS

On the Internet: See our Web site at <http://www.gernsback.com> for information and files relating to our magazines (**Electronics Now** and **Popular Electronics**) and links to other useful sites.

To discuss electronics with your fellow enthusiasts, visit the newsgroups sci.electronics.repair, sci.electronics.components, sci.electronics.design, and rec.radio.amateur.homebrew. "For sale" messages are permitted only in rec.radio.swap and misc.industry.electronics.marketplace.

Many electronic component manufacturers have Web pages; see the directory at <http://www.hitex.com/chipdir/>, or try addresses such as <http://www.ti.com> and <http://www.motorola.com> (substituting any company's name or abbreviation as appropriate). Many IC data sheets can be viewed online. Extensive information about how to repair consumer electronic devices and computers can be found at www.repairfaq.org.

Books: Several good introductory electronics books are available at RadioShack, including one on building power supplies.

An excellent general electronics textbook is *The Art of Electronics*, by Paul Horowitz and Winfield Hill, available from the publisher (Cambridge University Press, 1-800-872-7423) or on special order through any bookstore. Its 1125 pages are full of information on how to build working circuits, with a minimum of mathematics.

Also indispensable is *The ARRL Handbook for Radio Amateurs*, comprising 1000 pages of theory, radio circuits, and ready-to-build projects, available from the American Radio Relay League, Newington, CT 06111, and from ham-radio equipment dealers.

Copies of past articles: Copies of past articles in **Electronics Now** and **Popular Electronics** (post 1993 only) are available from our Claggg, Inc., Reprint Department, P.O. Box 4099, Farmingdale, NY 11735; Tel: 516-293-3751.

Electronics Now and many other magazines are indexed in the *Reader's Guide to Periodical Literature*, available at your public library. Copies of articles in other magazines can be obtained through your public library's interlibrary loan service; expect to pay about 30 cents a page.

Service manuals: Manuals for radios, TVs, VCRs, audio equipment, and some computers are available from Howard W. Sams & Co., Indianapolis, IN 46214 (1-800-428-7267). The free Sams catalog also lists addresses of manufacturers and parts dealers. Even if an item isn't listed in the catalog, it pays to call Sams; they may have a schematic on file which they can copy for you.

Manuals for older test equipment and ham radio gear are available from Hi Manuals, PO Box 802, Council Bluffs, IA 51502, and Manuals Plus, PO Box 549, Tooele, UT 84074.

Replacement semiconductors: Replacement transistors, ICs, and other semiconductors, marketed by Philips ECG, NTE, and Thomson (SK), are available through most parts dealers (including RadioShack on special order). The ECG, NTE, and SK lines contain a few hundred parts that substitute for many thousands of others; a directory (supplied as a large book and on diskette) tells you which one to use. NTE numbers usually match ECG; SK numbers are different.

Remember that the "2S" in a Japanese type number is usually omitted; a transistor marked D945 is actually a 2SD945.

Hamfests (swap meets) and local organizations: These can be located by writing to the American Radio Relay League, Newington, CT 06111; (<http://www.arrl.org>). A hamfest is an excellent place to pick up used test equipment, older parts, and other items at bargain prices, as well as to meet your fellow electronics enthusiasts—both amateur and professional.

game-show timer that was discussed in the December 1997 installment of this column.

Faking A Keyboard

Q I would like to use external switches to emulate the action of several of the keys on my PC keyboard. Do you have any suggestions? — S. O., Mississauga, Ontario, Canada

A A PC keyboard is not a simple device; in fact, it contains its own 8048 microprocessor. Accordingly, you're looking at a microcontroller project here. Some information about reverse engineering the PC keyboard is given in Application Note AN434, "Connecting a PC Keyboard to the I²C Bus," available from Philips Semiconductors, 811 E. Arques Avenue, Sunnyvale, CA 94088; Web: www.philips.com. You might seriously consider attaching your switches to a bidirectional parallel port, or some other i/o device, and writing a program to accept data from that device. Or simply connect your switches across those in the keyboard you're already using.

Name That Disk

Q I recently got a Seagate ST138I 30-megabyte hard drive from an IBM PS/2. Can I attach it to the IDE controller in my 80386 PC? — M. A. V., Brooklyn, NY

A No, because it's an ESDI drive, not IDE. Seagate manufactured many versions of their popular ST138 drive, all with different interfaces. The ST138I was custom-built for IBM and has an ESDI interface. What you need is an ST138A, with an AT bus IDE interface. Other variations include the ST138N (SCSI), ST138R (RLL), and plain ST138 (MFM). We got this information from *Pocket PC Ref*, a handbook published by Sequoia Publishing, Littleton, CO 80162-0820.

ESDI (Enhanced Small Device Interface) was introduced by Maxtor in 1983 but was seldom used anywhere other than on IBM PS/2s. Most PCs today use IDE or SCSI interfaces. While you could look for an ESDI controller, it's probably cheaper to get an IDE hard disk. Besides, even the cheapest hard disks today are a lot bigger than 30 MB.

Stepper Motor Query

Q Could you provide any good reference sources on the theory and use of stepper motors? Also, what about some sources to buy stepper motors? I have in mind to build a CNC milling machine. Thanks. — E. L. H., Travis AFB, CA

A You can find some help in the August, 1996 installment of this column; for more detailed information, get a copy of the book *Stepping Motors and Their*

Microprocessor Controls, by T. Kenjo and A. Sugawara, published by Oxford University Press (you can order it through any good bookstore). To get stepper motors for free, ask a computer shop for some discarded disk drives—the older and bigger the better. Old 5¼-inch diskette drives from the PC-XT era have especially good stepper motors. You can also buy stepper motors from Jameco, 1355 Shoreway Road, Belmont, CA 94002; Tel: 800-831-4242; Web: www.jameco.com, and many other component suppliers. Your computer-controlled milling machine sounds interesting; when you get it working, let us know!

Tank Circuit Components

Q I'm very new to electronics, and I'm interested in tank circuits (LC resonant circuits) used in radio receivers and the like. I realize it takes a myriad of equations to pinpoint components for specific frequencies, but couldn't someone devise a general chart to give a "ballpark" estimate of tank circuit component values versus frequency? — T. W. C., Fredonia, KS

A Your question is a good one. Actually, there's only one equation needed to calculate the resonant frequency of a tank circuit:

$$f = 1 / (2\pi\sqrt{LC})$$

or, solving for L and C respectively,

$$L = 1 / (39.5 f^2 C)$$

$$C = 1 / (39.5 f^2 L)$$

where L is in henrys, C is in farads, and f is in hertz.

As you've noticed, though, the practical question is what values to use. You can't use a 1-microhenry coil with a 1000-microfarad capacitor because the stray inductance of the capacitor would swamp that of the coil. Similarly, you can't use a 1-pF capacitor with a 1-millihenry inductor because the inductor itself has more capacitance than that.

Fortunately, there's a trick. Most radio circuits work well when C in picofarads is roughly equal to L in microhenrys—or at least when they're not terribly far apart. For example, you can generally use a 30-pF capacitance with a 10-μH or 200-μH inductance, because both 10 and 200 are reasonably close to 30. But don't try 30 pF with 30,000 μH.

Inductance	Capacitance	Resonant frequency
1 μH	1 pF	160 MHz
3 μH	3 pF	53 MHz
10 μH	10 pF	16 MHz
30 μH	30 pF	5.3 MHz
100 μH	100 pF	1.6 MHz
300 μH	300 pF	530 kHz
1 mH	1000 pF	160 kHz

FIG. 3—USE THESE VALUES for L and C as starting points when designing a resonant tank circuit, then tweak them as needed for your particular circuit.

Figure 3 shows the resonant frequencies for some values where L in μH happens to equal C in pF. Use it to get "in the ballpark" and then choose more precise values for the circuit you're building. In fact, common practice is to wind your coil by measuring the resonant frequency in the circuit, rather than the inductance; that way, stray capacitances and inductances are automatically taken care of. The *ARRL Handbook for Radio Amateurs* gives lots of useful information about designing tank circuits and winding coils.

Separating Voices From Noise

Q We have audio recordings of speech that is drowned out by static and noise. Do you know of a computer program or an electronic project we could build or buy to pull the voices out of the static? — B. S., Twentynine Palms, CA

A For years, the FBI, the CIA, and, to a lesser extent, the recording industry have used digital signal processing to improve sound quality. Now that computer hobbyists have sound cards, large hard disks, and Pentiums, there's no reason they can't do the same. No reason, that is, except that the software is very specialized, and we know of no one who is marketing it to consumers. Wait a few years, and the situation should improve.

Meanwhile, we suggest you look at the digital-signal-processing (DSP) boxes that ham radio operators use to pull voices out of noise. One of the least expensive devices of this kind is the RadioShack 21-543, which has been discontinued. It worked well except that the speaker volume was rather low,

which is irrelevant if you're feeding the output to a tape recorder. Maybe you can find one secondhand.

Ghost Story?

Q I connected my camcorder to my VCR to copy a tape. Meanwhile, I listened to music from a tape player in the same room, not connected to the VCR or camcorder in any way. When I played the tape back, the video was OK but I was shocked to hear the music that I had been listening to on the tape player. Can you explain how this happened? — P. G., La Salle, Quebec, Canada

A Does your camcorder have a mode that lets you record new sound over an existing video track? If so, maybe it was operating in that mode and recorded the sound through its microphone while copying the video from the existing tape. Or maybe the speaker of your tape player was close enough to induce some current in the audio cable between your camcorder and your VCR. Or maybe it's ghosts!

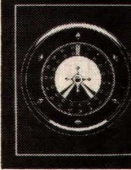
Writing to Q&A

As always, we welcome your questions. The most interesting ones are answered in print. Please be sure to include plenty of background information (we'll shorten your letter for publication) and give your full name and address (we'll only print your initials unless you want readers to contact you directly). If you are asking about a circuit, please include a complete diagram. Write to: "Q&A", **Electronics Now** 500 Bi-County Blvd., Farmingdale, NY 11735. Due to the volume of mail, we regret that we cannot give personal replies. **EN**

ELECTRONIC GAMES

BP69—A number of interesting electronic game projects using IC's are presented. Includes 19 different projects ranging from a simple coin flipper, to a competitive reaction game, to electronic roulette, a combination lock game, a game timer and more. To order BP69 send **\$8.00 (includes s&h)** in the US and Canada to **Electronic Technology Today Inc., P.O. Box 240, Masapequa Park, NY 11762-0240**. US funds only. Use US bank check or International Money Order. Allow 6-8 weeks for delivery. **MA07**

Electronic Games





LETTERS

SEND YOUR COMMENTS TO THE EDITORS OF ELECTRONICS NOW MAGAZINE

Missing Connections

A few errors have been brought to our attention concerning the "Portable Pulse Generator" construction project in the July 1998 issue of *Electronics Now*. In Fig. 1 on page 41, the emitter arrows were left off of transistors Q1-Q4. Transistors Q1 and Q4, being PNP types, should have their emitters connected to the 5-volt supply along with R9 and R13. Transistors Q2 and Q3, which are NPN types, should have their emitters connected to ground. Also, the emitter of Q1, along with R9, should be connected to the 5-volt supply in the same way that Q4 and R13 are connected.

In Fig. 2 on page 42, the cathode of LED1, along with C30 and the several pins of IC3 shown connected together, should be connected to ground. The ground symbol was left out on that schematic diagram.

We are sorry for any inconvenience that might have been caused—*Editor*

What Time is It?

Due to a production error, a piece of information was left out of the "S-Video Distribution Amplifier" construction article in the July 1998 issue. The last sentence at the bottom of page 36 that finishes on page 48 should read, "As an alternative, simply set the gain pot to a position of about *one o'clock* and set the trimmer capacitor..."—*Editor*

Who We Are and What We Want

Thanks for the invitation to write. I am a 31-year-old male technical professional. I spent four years working for a major computer manufacturer providing Technical Support, then Second Tier Technical Support, and finally training to Technical Support. I now develop database applications in the bakery industry. I have been an electronics hobbyist since 1980 and a computer enthusiast since 1982.

I watched *Popular Electronics*, under Ziff-Davis' care, dwindle from a great technical magazine to consumer-drivel and then die not long after becoming *Computers and Electronics*. Gernsback picked up the title and returned it to its roots. I don't want to see *Electronics Now* go that road.

What do I want? I want a hardware-oriented techie mag for people who love the smell of rosin in the morning. In the arena of projects, I want test equipment I can build for my workbench (digital AND analog), "dongles" to dangle from my computers, and gizmos to help me better enjoy my stereo. All things I can build.

In the arena of more general articles, I would like to see articles on theory: How do diodes rectify, how does Boolean Logic work, etc. I'd like to see interfacing techniques: How to decode addresses on ISA, how to use IRQ lines, and how to write drivers for home-built ISA cards. I would like to see articles on techniques: Various approaches to home fabrication of printed circuit boards, how to make attractive case cutouts and front panels, and how to effectively use an oscilloscope.

What I DON'T want to see is stuff like "Prototype." I was disappointed to discover it when my subscription renewal began. Your title is *Electronics Now* not *Electronics* sometime in the indeterminate future. If I want to know what's around the corner, *Popular Science* and *Scientific American* can give me that information. That is not what I want

from EN. I don't want to learn how to write HTML from EN. Sources for that information are as ubiquitous as death and taxes. I don't want to see what's new in consumer electronics unless it's a new technology that you are going to explain in detail. EN does not need to be contributing to the Gee Whiz marketing machine that sells TVs and Stereos. Do tell me how it will break and how to fix it. Do give me the theory of operation of any new technologies employed.

EN's value to me is in its focus on what makes technology tick and how to create it myself. I come to it to learn theories and techniques that allow me to increase my proficiency at my hobby. To learn what new tools and materials are out there to tinker with. Target the person who, either professionally or personally, works in a room that reeks of molten rosin. Focus on your core market: hobbyists and technicians seeking knowledge, theory, tools, and techniques for the creation and maintenance of digital and analog technologies.

RICH FURMAN

via e-mail

I am a degreed electrical engineer. I studied mathematics as an undergraduate, and went to graduate school in electrical engineering. I am involved with the design of advanced radar systems for the military.

I subscribe to your publication because I am interested in the hobbyist aspect of electronics. I also subscribe to *Circuit Cellar INK* and *Nuts & Volts*, which in my view are your closest "competitors" in the marketplace.

I am not very knowledgeable of hands-on electronics, so I use your publication to gain a passing familiarity with what's out there. I have not purchased or put together any of the projects in your publication, although I enjoy reading about them. My time is limited, and my construction skill is fairly poor. In addition, although I am involved in the design of large-scale systems, I am not involved

Write To:

Letters,
Electronics Now Magazine,
500 Bi-County Blvd.,
Farmingdale, NY 11735

Due to the volume of mail we receive, not all letters can be answered personally. All letters are subject to editing for clarity and length.

with the board-level design and assembly of subsystems.

In my spare time, I have done some work with electronics. I run a sound board at my local church and have fixed broken potentiometers on the board. I have also purchased scrap electronics through the advertisers I found in your magazine. I'll take the amps, fix switches or make simple connections on them, and then use them to provide sound to the church nursery, choir room, etc. I don't get involved with the assembly of the amp itself. I'm currently building a pair of speakers. I purchased the electronics from the advertisers in your magazine, and am building a plywood enclosure.

I like your magazine because it provides description of basic electronics. I'm not particularly interested in ham radio. I have some interest in computers, but my knowledge of software is good enough that I feel I could make a computer do whatever I wanted it to without the benefit of a publication of any sort to help me.

For me, in your magazine, "the simpler the better." I'm interested in basic circuits, so I read your "Q&A" column and short articles. I believe your magazine is unique and simply fills a void that is filled by no other publication.

JAY VIRTIS
via e-mail]

I am middle-aged, male, with two Associates Degrees, one in Electronics Technology, and the other in Computer Systems (hardware). My job listing is Technician, and I install, repair, and maintain computers and networks. I am the only Tech in a Division of 80-90 researchers.

My current position only requires me to "fire up the soldering iron" about once a month. Most of my computer repairs involve board swapping; I also build and string cable as needed. Some of the work involves 2-way radio, T-1 and 56 Kb phone lines, custom-built meteorology sensors, and video recording. We use Unix, Linux, and Microsoft software.

My hobby is also electronics. I've acquired a lot of test equipment from auction sales, and I repair consumer electronics in my home for friends and family. I've been on the Net for eight years and regularly read sci.electronics.xxx newsgroups. (Hi, Sam!)

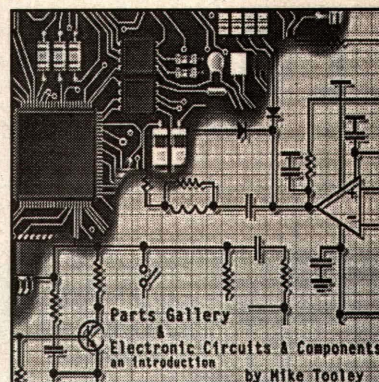
What do I want? I also read last month's editorial about source code.

(Continued on page 28)

NEW! ELECTRONICS CD ROM

**The most
effective way
of learning
electronics**

Two Courses on
one CD ROM!
Only \$56⁰⁰



Electronic Circuits and Components

Discover the standards and application of common types of electronic components and how they are used to form complete circuits in **Electronic Circuits and Components**. Sections on the disk include: Fundamental Electronic Theory, Active Components, Passive Components, Analog Circuits and Digital Circuits. The CD ROM includes:

- Interactive laboratories • Supervisor notes
- Full audio commentary • Editable worksheets
- About 20 links to pre-designed Electronics Workbench circuits

The Parts Gallery

Many students have a good understanding of electronic theory but still have difficulty in recognizing the vast number of different types and makes of electronic components. **The Parts Gallery** has been designed to help overcome this problem; it will help students recognize common electronic components and their corresponding symbols in circuit diagrams. This CD ROM incorporates a quiz so that students can check their knowledge of electronic components and symbols. The CD ROM includes:

- Over 150 component and circuit photographs • Supervisors notes
- Self-test Component and Symbol quizzes • Hundreds of electronic symbols

To Be Released Soon!

A series of interactive CD ROMs provides a comprehensive and up-to-date introduction to the world of electronics. The series provides a sound understanding of the principles and behavior of electronic components and the circuits to which they are connected. Two new CD ROM disks are to be released in the very near future. They are **Analog Electronics** and **Digital Electronics**. As soon as they are released, information on their contents and availability will be published.

Claggk Inc., PO Box 4099
Farmingdale NY 11735-0792
e-mail: claggk@poptronix.com



Name _____ Phone _____

Address _____

City _____ State _____ Zip _____

Enclosed is \$56 for each Student version of **The Parts Gallery** and **Electronic Circuits & Components** on a single CD ROM, shipping included inside the U.S. Shipping costs to Canada an additional \$3.00. Overseas orders please contact CLAGGK, Inc. for shipping costs.

I am ordering (....) copies at \$56 each. NY State residents must include sales tax.

☐ I have enclosed my check for \$ _____

☐ Please charge my credit card for \$ _____

☐ Visa ☐ MasterCard ☐ Discover Expiration Date: ____/____/____

Card Number _____ Signature _____

(Name on order and signature must be same as on Credit Card.)



EQUIPMENT REPORT

IBM HOME DIRECTOR LIGHTING AND APPLIANCE CONTROLLER

Give your home that lived-in look and add computer-controlled automation of lights and appliances with the IBM Home Director Starter Kit.

CIRCLE 15 ON FREE INFORMATION CARD



There comes a time when every homeowner considers investing in home security equipment; often it's after being terrified by an item on the evening news. But then most people quickly pass on the idea when a more pleasant news item flashes across the screen or when the person considers how much money it might cost to install home-security equipment—not to mention the work that's involved in most installations that are not "professionally" done.

However, not all home-security products cost a lot of money, and some can be installed in no time. Consider, for example, IBM's Home Director Starter Kit. That \$99 package provides a homeowner with automated security, control, and convenience, and the installation could be completed in a matter of minutes. The Starter Kit consists of three line-carrier controlled modules and an RF/infrared hand-held remote control. Additional modules can be purchased from IBM, and compatible modules are commonly available from multiple sources and multiple manufacturers. A PC-compatible computer running Windows 3.1 or Windows 95 is required.

Home Director can be used to turn on lights automatically. That's useful for giving your home a "lived-in" look when you are away. But the Home Director's usefulness does not stop at security. It also can be used to give your home a touch of automation. For example, it can be set to turn on your house lights shortly before you are scheduled to return home. You

could also set it up to turn on certain groups of lights in the early morning hours so you don't have to stumble around in the dark while you are barely awake. Other possibilities include having your coffee ready when you wake up, even if you wake up at different times during the week and on weekends. Or perhaps you'd like to turn on an electric blanket every night before you go to bed so that the bed's not cold when you get there—all that, and more, is possible with the Home Director.

Home Director

The theory behind the operation of the Home Director is relatively simple. All of the modules plug into AC outlets connected to a home's electrical wiring. Information-bearing signals then ride on top of the AC voltage, allowing the modules to communicate with one another. Lights and appliances plug into the modules and turn on or off according to the commands received by the particular module.

One of the modules, the PC Connection Module, connects to a PC's serial port. Simple commands, or even complex routines, are set up on the PC and then downloaded to the PC Connection Module. The PC Connection Module is basically the controller of the Home Director system. Once routines are downloaded to the PC Connection Module and stored in memory, the computer can be turned off. The computer is needed only if it becomes necessary to change the routine.

Each of the three modules included with the Starter Kit is unique. The PC Connection Module not only receives and stores routines downloaded from the PC, it also has its own AC outlet that can power a plugged in light or appliance. The Remote Module also plugs into an AC outlet and has its own outlet to power a light or appliance, but it also has an antenna that receives RF commands from the Home Director remote control. The remote control can be used to manually turn on or off any light or appliance in the system from any room in the house.

The third module, a simple Lamp Module, receives commands only from the AC wiring. Any light or appliance plugged into the Lamp Module can be controlled from the PC Connection Module or the Remote Module. The Lamp Module can not only turn a connected light on and off, it can also be used to dim or brighten that light either manually or automatically. Each module has a code, or address, that is used to identify it in the system. Codes can be changed so that additional modules can be added to the setup.

The remote control is a lot more than just a remote control for the Home Director system. Not wanting to stick people with yet another remote control to keep on the coffee table, IBM equipped the remote with options to control nearly any TV, VCR, cable box, satellite tuner, and two auxiliary devices. All of the Home Director functions, plus the functions of any of the above devices, can be controlled via the remote.

Just like any other "smart" remote, the Home Director remote has buttons that put it in one of seven modes (Home Director, TV, VCR, Cable, Aux 1, Aux 2, and Satellite) to control a particular device. An included manual lists the command codes for almost every brand of electronics available in this country. The remote can even be set to try hundreds of code combinations until it finds

(Continued on page 24)

Prototype

Cruising Down the Asphalt and Information Highway

Caught in a traffic jam, you spend the downtime reading your e-mail, checking the balance in your bank account, and finding out last night's sports scores. Your wife in the passenger seat surfs the Internet. In the back seat, your daughter watches a movie while your son plays video games.

Sound pretty futuristic? Well, vehicles with those capabilities could be in dealer's showrooms in as short a period as four years, and some of the individual features could appear sooner. When high-power computers are combined with the Internet, wireless communications and other electronic technologies, drivers and passengers could be as productive as when they are in front of their desktop computers or as entertained as when sitting on their couches. Recognizing the huge potential of installing Internet-capable computer systems in vehicles, automakers working with their computer and electronic suppliers are developing vehicles in which modem speed and megabytes are of equal, and maybe greater, interest than top speed and miles-per-gallon.

The *Network Vehicle* developed jointly by General Motors' Delphi Automotive Systems, IBM, Sun Microsystems, and Netscape is one showcase of the services that could be provided to drivers and passengers when "intelligent" vehicles are connected to the Internet. The Network Vehicle integrates "off-the-shelf" computer hardware and software technologies, wireless communication, Java operating system, Global Positioning System, and Internet/intranet capabilities. Voice recognition and speech synthesis, direct-broadcast satellite reception, reconfigurable heads-up display (HUD), center-console and passenger displays, and mobile media link (MML) are also featured in this electronic concept car.

A flat satellite antenna embedded under the Network Vehicle's roof panel



THE NETWORK VEHICLE concept car is a joint effort of IBM, GM, Sun, and Netscape.

provides a direct link to the Internet through Hughes' DirecPC satellite. The system allows high-speed download of audio, full-motion video, and text data. Operating at 400 kbps, it is more than 15 times faster than a standard 28.8 k modem. The antenna also receives programming from Hughes' DirecTV, so passengers can watch their favorite television programs while traveling.

Keep Your Eyes on The Road

Operating a computer using a keyboard, mouse, or other normal input device is not appropriate in a mobile environment, especially for the driver. Therefore, the Network Vehicle uses voice-recognition with speaker identification and speech synthesis, a heads-up display (HUD), touch screens, and steering-wheel controls so these high-tech systems can be safely used without taking hands off the steering wheel and eyes off the road.

IBM modified its advanced ViaVoice speech recognition and text-to-speech response system for the Network Vehicle. The speech recognition system can understand most drivers instantly, requires no training, and has been tuned for optimal performance even inside a noisy vehicle. With ViaVoice, the driver can check e-mail and voicemail; get directions and information on traffic conditions from the on-board navigation system; locate a restaurant or hotel on the Internet, or obtain news, sports scores, and stock prices. Voice commands can also lock/unlock doors, play CDs, select radio stations, and so forth.

The reconfigurable HUD projects information onto the windshield so that drivers can view road speed, engine status, e-mail waiting messages, navigation information, microphone on/off status, and so forth without taking their eyes off the road. A text message area is available to provide feedback to voice commands



DRIVERS CAN ACCESS all the Network Vehicle's features using spoken commands or the reconfigurable touch-screen command console on the dashboard, located between the driver and passenger seats.

showing they have been received.

The center console's touch screen serves as a heads-down display (HDD) for nearly all of the functions on the Network Vehicle including the audio system, climate control, cellular phone, and mobile-office gadgetry for everything from e-mail to Web browsing. Using standard graphics, it displays the usual instrument-panel items like speedometer, tachometer, fuel level, oil pressure, coolant temperature, and door-ajar warning. The cluster display can be reconfigured uniquely to suit the mode currently being used. For instance, in the entertainment mode, the faceplate display looks like a radio or CD-player face with touch-activated controls. Other reconfigured displays include those for e-mail, Web browsing, navigation maps, or cellular phone. Likewise, steering wheel controls are reconfigured according to current function being used, with the configuration shown on

the center-console screen. Voice-activated commands can be used with all of the center-console functions and, in some cases, text-to-speech to minimize driver distraction.

There are three individual passenger-color LCD displays with touch panels for the front-seat and back-seat passenger seats. They provide enhanced features beyond those found in the center console display. This includes programs from DirecTV, videos from DVD video players, Net surfing via DirecPC, and a variety of office functions. Like the other displays, these are reconfigurable according to the current function.

Wherever possible, the Internet, probably via a dedicated automotive ISP (Internet service provider), would be used to provide information and communications. For instance, trip planning including maps, route guidance, hotel and restaurant information, and concierge services while traveling would come off the Internet and be combined with GPS position data. Owners of the Network Vehicle use their Web browser to set up a personal profile, including preferences in radio stations, preferred personalized audio content, vehicle-service records, and emergency-service numbers.

A slot in the center console accepts an IBM WorkPad Personal Data Assistant (PDA), which interfaces with the Network Vehicle's computer to add

speech recognition and text-to-speech capability. This PDA connection enables the driver to listen to schedules and to update files and other office data stored in the WorkPad. For example, the driver can give a voice command to read calendar entries from the WorkPad or dictate a to-do list while driving. As PDA and smart card technology advances, PDAs in the Network Vehicle could be used to access personal, financial, and business information while traveling.

The driver would have instant access to electronic maintenance and service records for the vehicle. The Network Vehicle also has capability to diagnose engine problems. Should the diagnosis indicate a problem, the computer could notify the automaker's customer service Web site where the severity of the problem would be determined. Depending on the problem, a service representative could alert the driver via the Internet and the Network Vehicle's HUD or text-to-speech capability, as well as set-up an appointment for repairs by, for example, e-mail.

Connecting all this in-vehicle electronics together is a low-cost, fiber-optic serial data link called Mobile Media Link (MML). With MML's high bandwidth, multiple audio, video, and control data can be transmitted across the fiber-optic bus at ultra high-speeds.

Other Vehicles

The Network Vehicle is not the only prototype/concept car with combined computing/entertainment/productivity/transportation features. For example, Delphi Delco Electronic System's Mecel AB division working with Saab developed the *Personal Productivity Vehicle* around a 1999 Saab 9-5. Choosing a Saab for the Personal Productivity Vehicle is not surprising since nearly 30% of Saab owners are already Web users. It features advanced technology for communications and mobile computing as well as more traditional entertainment. The Personal Productivity Vehicle uses the Microsoft Windows CE-based AutoPC platform with integrated AM/FM receiver, CD-ROM, serial-port interface, universal serial bus, COMPACTFLASH expansion slot, and a high-resolution 256 by 64 display. For safe usage while driving there are steering-wheel controls, plus interactive speech recognition and speech

FOR MORE INFORMATION

Network Vehicle

www.alphaworks.ibm.com/networkvehicle

Personal Productivity Vehicle

www.delco.com/delco/delcoprod.html

ICES

www.visteon.com



DISPLAYS AND CONTROLS for the Visteon ICES system.

synthesis reading/sending e-mail as well as for receiving navigation, traffic, and weather information, or just to change the radio station.

Besides normal cellular communications, an infrared data link is available for transferring data between the vehicle and Windows CE-based devices such as handheld and palm PCs. Like the Network Vehicle, the Personal Productivity Vehicle uses the ultra-high-speed fiber-optic MML serial data link for high-bandwidth connectivity within the vehicle. MML, which is capable of signal transmissions rates of up to 110 Mb/s, and can support up to 50 channels of audio and 20 channels of TV-quality compressed video.

Ford's Visteon Automotive Systems has developed its *ICES* concept vehicle. The acronym stands for Information, Communications, Entertainment, Safety, and Security.

Visteon's multimedia "vehicle computing platform" uses Intel architecture microprocessors and the Microsoft Windows CE operating system. Drivers will be able to customize their personal computer on the road with their favorite features by simply installing new software just as with a home or office PC.

ICES extends the electronic environment of the home and office to the vehicle, delivering Internet access as well as emergency service and everything in between, including cell phone, climate control, high-quality audio, and even movies for rear-seat passengers. By using state-of-the-art voice and naviga-

tion technology, ICES will tell a driver about traffic snarls as they occur and suggest time-saving alternate routes. The system can also listen to and understand the driver's requests to map new routes. ICES uses Visteon's voice system, which is speaker-independent. This means it recognizes natural speech patterns as well a range of voices, languages, and dialects.

ICES also uses RESCU (Remote Emergency Satellite Cellular Unit) already offered in Lincoln Continentals. Combining GPS and a cellular phone network, RESCU provides emergency and breakdown assistance, automatic air bag deployment notification, and convenience features like route assistance and concierge services.—**Bill Siuru** **PT**

Micron Breakthrough in Semiconductor Technology

A University of Texas graduate student research team led by Dr. Grant Wilson, professor of chemistry and chemical engineering, has successfully completed a project to print 0.08-micron features on a semiconductor wafer. The project was funded by SEMATECH, a non-profit research consortium of ten semiconductor manufacturers.

The breakthrough is especially impressive since it was achieved with a 193-nm Deep Ultraviolet (DUV) ISI 103 stepper. Many industry experts had believed it would be necessary to develop new post-optical technology to produce feature sizes at or below 0.10 micron. One micron is the equivalent of approximately 1/25,000 of an inch.

The 0.08-micron features, which are approximately 320 atoms wide, were generated using an etched-quartz phase-shift photomask produced by DuPont Photomasks, Inc. Photomasks are high purity quartz plates that contain precision images of the features that are patterned onto semiconductor wafers with lithography steppers to build integrated circuits. Since building photomasks for semiconductor production becomes progressively more difficult as feature sizes

shrink, special techniques such as phase shifting must be incorporated. Phase-shift photomasks function by allowing a small percentage of the light through while simultaneously altering the phase of the light transmitted, improving focus and increasing resolution.

Another essential component in semiconductor manufacturing is the photore-sist. Amorphous polyolefin, the photore-sist used by the University team, took three years to develop. The polymers had to be specifically designed to work with the 193-nm wavelength DUV light source used by the stepper to pattern the image at the required feature sizes onto the semiconductor wafer.

Currently, the most advanced commercial semiconductor designs are manufactured using 0.25-micron process technology. The Semiconductor Industry Association's most recent revised roadmap did not call for 0.08-micron feature sizes until the year 2009. According to Dr. Wilson, "I didn't believe it could be done at first. It really works better than my wildest imaginings, and it appears that the process latitude is there to generate smaller features yet."

Kyle Patterson, a University of Texas graduate student on the research team, presented the results of the project at a meeting of the Society of Photo-Optical Instrumentation Engineers (SPIE) in Santa Clara, CA. **PT**

The Hole Truth

Workers who have to handle radioactive, biological, or toxic materials could find better protection with a recently patented idea developed by Los Alamos researchers. The new method uses alternating layers of conducting and insulating materials in protective gear. Tests have demonstrated that even a small puncture can change the resistance or capacitance between the two layers, signaling a breach. Checking for changes in the electrical properties of the conductive layers produces signals of punctures or other breaches, in real time.

Various materials and techniques are available for manufacturing multi-layer protective barriers with the required electrical properties. Such materials could be used in containment bags; liners and covers for storage containers; or

in protective apparel such as gloves, aprons, and boots.

Providing continuous monitoring and real-time detection, the method would improve worker safety, better protect the environment, and reduce costs—all by initiating a decontamination response before contaminants or toxins have spread significantly. **PT**

Tracing the Origin of Water

A team of U.S. astronomers has located a large concentration of water vapor within the Orion molecular cloud—a giant interstellar gas cloud

1500 light years from the Sun, composed primarily of hydrogen molecules. The concentration of water vapor in Orion—20 times larger than any previously detected—was measured using the long-wavelength spectrometer, one of four science instruments aboard the Infrared Space Observatory satellite. The data *signature* characteristic of water-vapor emission was observed in the far-infrared region of the electromagnetic spectrum.

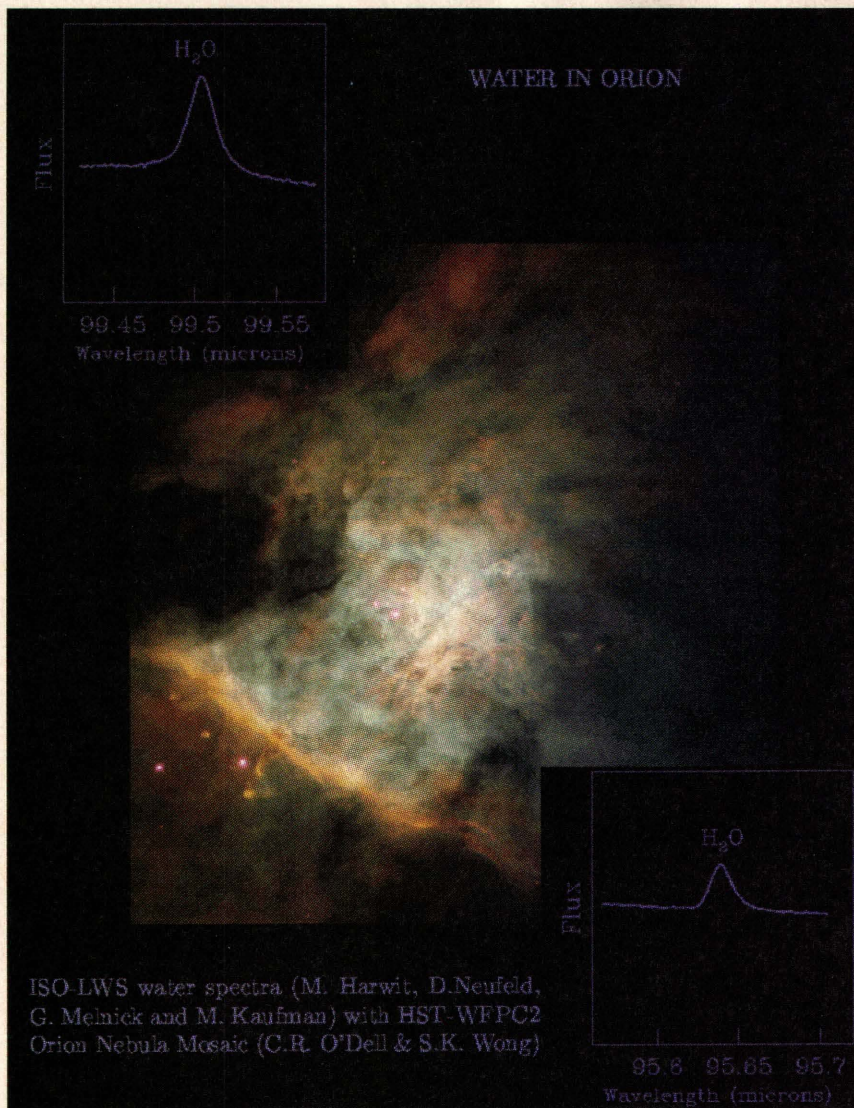
According to the research team, the high concentration of water in Orion may be key to the origin of solar system water. The shock waves given off by young stars in the interstellar gas cloud function as a huge *chemical factory*, the

team reported, generating enough water molecules in a single day to fill 60 Earth oceans. Eventually, the water vapor turns into ice particles, similar to those thought present within the gas cloud from which our solar system formed.

The water vapor concentrations measured were roughly one part in 2000 by volume. The cloud's fast-moving shock waves made the gas cloud abnormally warm. For more than 25 years, astrophysicists have predicted that, when the temperature exceeds 200 degrees F, chemical reactions will cause most oxygen atoms in the interstellar gas to combine with hydrogen atoms to form water.

"We've known for some time that a young star in Orion is ejecting material into the surrounding gas and dust cloud causing violent shock waves," said team member Dr. Michael Kaufman, an astrophysicist at NASA's Ames Research Center, Moffett Field, CA. "These new observations confirm our prediction that these shock waves produce large amounts of water."

NASA researchers will continue to study water vapor in the Orion cloud to better understand the role water plays in the formation of stars and planetary systems. NASA's forthcoming Stratospheric Observatory for Infrared Astronomy (SOFIA) will begin science research flights in November 2001 looking for this type of water emission, among other things. SOFIA is a next-generation flying research laboratory housed in a converted 747-SP aircraft that will conduct observations of the solar system, stars, and galaxies in the infrared region. **PT**



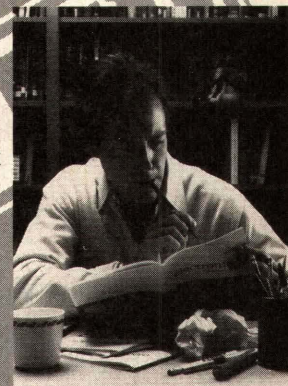
THE PRESENCE OF WATER VAPOR NEAR THE ORION nebula is indicated by an increased flux of infrared radiation at specific wavelengths.

Chaos and Secrecy

Research reported in the journal *Science* could lead to development of a new technique for encoding information sent across optical fiber systems that are now widely used for telecommunications. The technique mixes a confidential message with a chaotic carrier signal, transmits it, then subtracts the chaos to reveal the message. The key to success is synchronizing two nearly identical lasers to produce the same chaotic pattern on both the sending and receiving ends. The work is the first use of chaos to carry messages in an all-optical system. **PT**

1 Study at Home

We live in a constantly changing world, where exciting new technological advancements are made everyday. At the Cleveland Institute of Electronics we make it simple to train, earn a degree and prosper in the workforce. Over 150,000 students in the United States and 70 foreign countries got their start in electronics through CIE. And they received their education at their own pace in the comfort and convenience of their homes. At CIE you'll receive a first class education by a faculty and staff devoted to your career advancement. All of CIE course and degree programs are taught through a patented, proven learning process. To discover all the benefits and programs/ degrees available from CIE send for your free course catalog today.



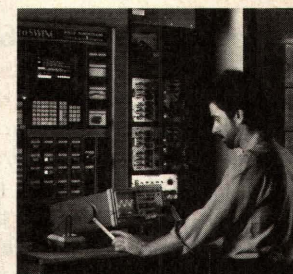
CIE's Associate Degree program contains 397 lab experiments.

2 Work Where You Want

And once you complete your education at CIE, you can just about write your own ticket to where you want to work and in what specialized field... MIS, broadcasting, industrial, automotive, management... The opportunities seem limitless in today's high-tech world.

The Cleveland Institute of Electronics has been approved for use of Veterans Affairs Benefits and DANTES Tuition Reimbursement.

Tuition assistance from the Veterans Administration or the DANTES Program is available to veterans and service members in the Armed Forces.



Employees are seeking & hiring qualified applicants.

FREE CATALOG



1776 E. 17th Street
Cleveland, Ohio 44114-3679

Visit Our Web-Site
www.cie-wc.edu

☐ **YES!** I am interested.
Please send me a catalog.

Name: _____

Address: _____

City: _____ State: _____ Zip: _____

Phone Number: _____

A school of thousands. A class of one. Since 1934.

AE128

Generating Random Numbers

D ID YOU EVER THINK ABOUT DEVELOPING A FOOLPROOF METHOD OF WINNING THE STATE LOTTERY? AT THE HEART OF YOUR SYSTEM YOU PROBABLY HAD A RANDOM-NUMBER GENERATOR—PREFERABLY A PORTABLE ONE. DOESN'T SOUND THAT

hard: Just slap together a little 16-character LCD, a microcontroller, and a way to generate random numbers. It couldn't be that difficult, could it? Guess again.

I'll tell you right now that hardware is your best bet. Nonetheless, for the sheer pleasure of it, we're going to beat our heads against the wall and see what we come up with software-wise. If that doesn't convince you, I've got 200 pages of dense mathematics for you to read.

What Is A Random Number?

Glad you asked. Actually, a number is just a number; there's no such thing as a random number. What's important is to be able to generate sequences of unrelated or apparently unrelated numbers. That "apparently unrelated" is the catch. It implies some sort of relationship between the generator and the user. The point is that even if a sequence is not random, if the user thinks it is, that's good enough.

People who are used to programming in high-level languages typically use a function like one of those shown in Table 1 to generate random numbers. Typically, you call the seed function first with some "random" value that kicks things somewhere in the middle of the sequence—hopefully differently from the last run.

Note that there is no assembly-language function. Life would be easier for lots of people if CPU designers incorporated a read-only "random" register that

ripped along at some multiple of the basic clock frequency.

Of course, those high-level functions just call underlying library code, which is what does the work. People who analyze the output of library generators typically find them lacking, so be warned. If you

need high-quality random number sequences, look elsewhere.

There are many methods for generating sequences of random numbers. The most popular is called the linear congruential method, which was invented by D. H. Lehmer in 1949. The chief characteristics of the Lehmer method are that it is simple, deceptive, insidious, and maddening.

The Lehmer Generator

The basic formula is simply:

$$x(i+1) = (a * x(i) + c) \bmod m$$

LISTING 1—QBASIC RANDOM-NUMBER GENERATOR

```
REM A multiplicative congruential random-number or Lehmer generator
REM basic formula: x(i+1) = (a*x(i) + c) mod m
REM from C User's Journal, June 1995, Jerry Dwyer
REM jkh, 2/28/98
```

```
DIM c AS INTEGER
DIM m AS INTEGER
DIM i AS INTEGER
```

```
DIM Count AS INTEGER
DIM Seed AS INTEGER
```

```
DIM x AS INTEGER
DIM y AS INTEGER
```

```
a = 5
c = 0
m = 7
```

```
Count = 100
Seed = 1
```

```
PRINT "_____ "
x = Seed
FOR i = 1 TO Count
    y = (a * x + c) MOD m
    PRINT x;
    x = y
NEXT i
```


LISTING 2—LEHMER GENERATOR IN C

```

/*
** longrand() — generate 2**31-2 random numbers
** public domain by Ray Gardner
** based on "Random Number Generators: Good Ones Are Hard to Find",
** S.K. Park and K.W. Miller, Communications of the ACM 31:10 (Oct 1988),
** and "Two Fast Implementations of the 'Minimal Standard' Random
** Number Generator", David G. Carta, Comm. ACM 33, 1 (Jan 1990), p. 87-88
** linear congruential generator f(z) = 16807 z mod (2 ** 31 - 1)
** uses L. Schrage's method to avoid overflow problems
*/

#define a 16807 /* multiplier */
#define m 2147483647L /* 2**31 - 1 */
#define q 127773L /* m div a */
#define r 2836 /* m mod a */

long nextlongrand(long seed)
{
    unsigned long lo, hi;

    lo = a * (long)(seed & 0xFFFF);
    hi = a * (long)((unsigned long)seed >> 16);
    lo += (hi & 0x7FFF) << 16;
    if (lo > m)
    {
        lo &= m;
        ++lo;
    }
    lo += hi >> 15;
    if (lo > m)
    {
        lo &= m;
        ++lo;
    }
    return (long)lo;
}

static long randomnum = 1;

long longrand(void) /* return next random long */
{
    randomnum = nextlongrand(randomnum);
    return randomnum;
}

void slongrand(unsigned long seed) /* to seed it */
{
    randomnum = seed ? (seed & m) : 1; /* nonzero seed */
}

#ifdef TEST
#include <stdio.h>
#include <stdlib.h>

int main(int argc, char *argv[])
{
    long reps, k, num;
    unsigned long seed;

    reps = 10000;
    seed = 1;

    /*
    ** correctness test: after 10000 reps starting with seed 1,
    ** result should be 1043618065
    */

    if (argc > 1)
        reps = atol(argv[1]);
    if (argc > 2)
        seed = atol(argv[2]);

    printf("seed %ld for %ld reps...\n", seed, reps);
    slongrand(seed);
    for (k = 0; k < reps; ++k)
        num = longrand();
    printf("%ld\n", num);

    return 0;
}

#endif

```

In words, to get the next value, take the current value, multiply it by a, add c to it, divide by m and take the remainder. Choosing good values for a, c, and m is not simple. Bad values quickly degenerate into non-random sequences. Listing 1 shows a little QBasic program to play with.

For short runs, the algorithm is worthless, because it repeats quickly. For example, suppose you wanted to create an electronic dice game, producing random numbers between 1 and 6. The QBasic program in Listing 1 produces the following results:

```

1 5 4 6 2 3 1 5 4 6 2 3 1 5 4 6
2 3 1 5 4 6 2 3 1 5 4 6 2 3 1 5
4 6 2 3 1 5 4 6 2 3 1 5 4 6 2 3
1 5 4 6 2 3 1 5 4 6 2 3 1 5 4 6
2 3 1 5 4 6 2 3 1 5 4 6 2 3 1 5
4 6 2 3 1 5 4 6 2 3 1 5 4 6 2 3
1 5 4 6

```

You probably wouldn't want to create a dice game based on that.

For best results, the value of m should be the data-bus width of your CPU ± 1 . On a 32-bit CPU, a good value is $2^{32}-1$ (= 2,147,483,647), which happens to be a prime number. (By the way, m and a should be relatively prime.) A good value for a is 16807. Unfortunately, you can't use the value 2147483647 in QBasic (it's 16-bit). You can use 32767, which seems to work pretty well.

The C code in Listing 2 is a 32-bit variant that codes around potential overflow problems due to the use of signed integer arithmetic. Obviously that's not a problem on any modern computer, but it's a different story on, say, an 8-bit microcontroller.

Also Keep In Mind

As you think about the problem, here are a few other things to keep in mind:

- There are other algorithms, but they take lots of code.
- Verifying randomness and distribution are not trivial tasks. A degree in statistics would help.
- You can't simply feed the output of one random-number-generator routine to the input of another to increase randomness.

For some background and algorithms, see the 6/95, 6/96, and 8/96 issues of *C/C++ User Journal*. For a comprehensive treatment, the new version (Vol. 2, 1998) of Donald Knuth's *The Art of Computer Programming* has more than

TABLE 1—RANDOM NUMBER FUNCTIONS IN VARIOUS LANGUAGES

Language	Seed Function	Generator Function	Returns
MS QBasic	Randomize	Rnd	Single precision value $0.0 < n < 1.0$
ANSI C	srand	rand	integer $0 \leq n \leq \text{RAND\_MAX}$
Java	srandom	random	single $0.0 < n < 1.0$
Pascal (Borland Delphi)	Randomize	Random (range)	single, $0.0 \leq n < 1.0$, or integer $0 \leq n < \text{range}$

you'll ever want to know (nearly 200 pages) about random-number generation. He suggests using Chapter 3 as the basis of a semester course for college senior or grad students. He doesn't even acknowledge the existence of CPUs of less than 16 bits.

I don't believe there is an efficient random number generator for an 8-bit CPU. Depending on your needs, you'll probably have to do double- or quad-precision adds and multiplies.

Hardware Solutions

Perhaps the easiest way is to set a timer to fire at a rapid rate relative to the tasks done by your application. Then, each time it fires, increment the count in a register. It's like the "tick" count in a PC. For that to work, your usage will occur at random intervals relative to the clock (*e.g.*,

user events such as pressing a switch). Of course, it assumes that you have a timer, and that you're not using it for anything else. If you are, multiplex the timer interrupt and maintain separate counts.

Registers and RAM are typically uninitialized (*i.e.*, they have "random" values). Use one such value to seed the timer. In this case, the timer would run at a different rate every time you boot.

Conclusions

Do you have an algorithm for generating pseudo-random number sequences on an 8-bit microcontroller? Are you confident that it works? If you can answer yes to both questions, send in your method. I'll run it through some tests, and if it survives, I'll publish the results here. See you next time; stay in touch via e-mail at jeff@ingeninc.com. **EN**

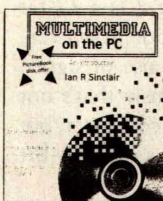
outlets anywhere in your home; their specific locations are determined by what items you want to control and where those devices are located.

Next you have to install the software that is provided on a CD-ROM. The software presents a simple graphical interface that lets you install and configure modules in the system. Each module and its functions are graphically depicted in the software interface, and a right mouse click brings up various options for each module. All of the lights and appliances in the system can be controlled directly from the PC, and at this point you can test any of the attached devices.

Included with the software are a couple of sample routines that you can test out. One routine turns on a lamp at 50% brightness, immediately turns on an appliance, turns the lamp up to 100% brightness after five minutes, turns off the appliance after 10 minutes, and then turns off the lamp after 15 minutes. You can write your own routines or edit the supplied routines according to your own needs. You can give each routine a unique name and even label the modules according to the appliances you have plugged into them. You might want to define wake-up and goodnight routines, or perhaps weekday and weekend routines.

The routines allow you to tailor your lighting and appliance scheduling for each day of the week. To save time, the software lets you duplicate and drag-and-drop parts of one routine into another routine. Because a PC keeps track of the date and time, advanced functions let you make custom routines for specific dates or even configure dawn and dusk routines once you have entered your time zone—the software then knows when the Sun comes up and when it goes down where you live, and it even accounts for Daylight Savings Time.

IBM's Home Director Starter Kit is just the ticket for people who would like to automate the lights and appliances in their home without spending a lot of money on equipment or a lot of time on installation. And with readily available expansion modules, the system is fully customizable. If you already have a PC, you already own the most expensive part of the system. Now all you need is the Home Director. For more information, contact IBM (Route 100, Somers, NY 10589; Tel: 800-426-7235, Ext.4340; Web: www.pc.ibm.com/homedirector) directly, or circle 15 on the Free Information Card. **EN**



MULTIMEDIA on the PC!

What is Multimedia? What can it do for you? It can do lots of nice things! This 184-page book helps you create your own multimedia presentation.

Multimedia applications by people like you can revolutionize educational and business applications as well as bring more FUN, FUN, FUN into your leisure computer activities.

Mail coupon to:

**Electronics Technology Today, Inc.
P.O. Box 240
Massapequa Park, NY 11762-0240**

Please send me my copy of *Multimedia on the PC* (PCP120). I enclose a check or money order for **\$18.95** to cover the book's cost and shipping-and-handling expenses. NY state resident must add local sales tax.

Name

Address

City State Zip

All orders must be paid in U.S. funds only. Sorry, no orders accepted outside of USA and Canada. Please allow 6-8 weeks for delivery. MA02

EQUIPMENT REPORT

continued from page 14

the right command set—it then tells you what the proper code is. To top it off, the remote even has a built-in light that illuminates the buttons—you might want to use it to replace your present remote control.

Setup

The Home Director Starter Kit is very easy to set up. First you have to install four AAA batteries in the remote and two AAA batteries in the PC Connection Module—those two batteries preserve the routines stored in the module's memory even in a power outage. The PC Connection Module must be plugged into an outlet near your computer. An included cable connects the module to the serial port on the PC. A light or appliance that you wish to control is then plugged into the PC Connection Module. The Lamp Module and Remote Module can be plugged into

Troubleshooting CD-Player Startup Problems

A STARTUP PROBLEM IS A CATCH-ALL TERM FOR ANY SITUATION WHERE A CD PLAYER OR CD-ROM DRIVE REFUSES TO RECOGNIZE OR PLAY/ACCESS A DISC. IN THIS MONTH'S INSTALLMENT WE'LL DESCRIBE IN DETAIL WHAT HAPPENS WHEN

you insert a CD and push PLAY, and we'll look at what to do if the unit doesn't want to cooperate.

What's a Startup Problem?

With an old-style record player (you know, vinyl LPs, technology that was state-of-the-art sometime before dinosaurs roamed the earth), the tone arm could be plunked down anywhere to start play. Not so with a CD player. Aside from the fact that you cannot even get to the pickup on a CD player to move it by hand and plunk it down, a lot must take place successfully before the first note is sent to your loudspeakers.

Startup problems cover all situations where the player does not successfully read the disc directory. Nearly everything in the optical deck and much of the main-board electronics needs to be functional to read the directory. Therefore, any failure in any of a rather large number of places can prevent successful startup (and subsequent play).

On a changer, a startup-sequence failure will probably result in similar symptoms, but then the unit will move on to the next position in the carousel or cartridge. It is likely that the player will remember that it was unsuccessful at loading a disc for each position and eventually give up after all possible discs have been tried.

Possible causes of a startup-sequence failure include a defective disc, dirty lens, defective laser or photodiode array, bad

focus or tracking actuator or driver, dirty track, insufficient or dried-up lubrication, dirty or bad limit switches or sensors, defective spindle motor, faulty electronics or control logic, damaged parts, faulty optical alignment, and/or need for servo adjustments. The bad news is that this is a large number of possibilities. The good news is that with such a large number of possibilities, there is a good chance that the problem will be minor and inexpensive to fix; actual failure of the (expensive) optical pickup itself is relatively far down the list of likely causes.

First, be sure that you do not overlook the trivial: Are you loading the disc correctly? Most CD players want the disc label-side up. However, there are some, like Pioneer magazine-type changers, that want the label-side down. If you have just acquired the CD player, don't overlook that possibility.

Startup Sequence

The exact sequence of startup events and the symptoms they cause when they fail will vary depending on the type of player and its design. For example, the display might flash, be blank, display "—:—" or the word "disc" or "error," etc. In any event, the unit won't play the disc. By understanding the following summary as it applies to your player, you should be able to determine what is going wrong.

When a CD is inserted, the player should go through the following routine:

1. Drawer closes (or with portables,

lid is closed manually) and CD is clamped to the spindle.

2. Interlock engages, if present (always in portables). If there is no interlock, there may be an optical sensor or the optical pickup may act as its own disc sensor.

3. Pickup resets to starting (index) location towards center of disc, which is usually located using a limit switch or optical sensor.

Before describing the remaining steps, it would be helpful to explain a bit more about the organization of the photodetector. The illustration in Fig. 1 is typical of units that have a three-beam pickup. Blocks E and F are not present (or at least not used—they will be disabled and grounded) in units that have a single-beam pickup. The four-quadrant (ABCD) photodetector is found in all systems. The main return beam is detected by the ABCD array. The tracking beams return to E and F. Detector E is offset slightly off track to one side and F is offset to the other. Average signals from E and F will be equal when the array is centered on the track. Now, let's return to our discussion.

4. Laser is turned on and focus search routine is started to position the lens at the correct vertical position. Once correct focus is achieved, the focus servo is activated to maintain it. Focus, which must be accurate to 1 μm , operates as described in the next paragraph.

5. The optical path in the pickup includes a cylindrical lens or astigmatism that causes the laser-beam spot to be circular when it is correctly focused, but elliptical when it is not. When it is not correctly focused, the major axis of the ellipse is offset 90 degrees, depending upon whether the lens is too close or too far (e.g., major axis of -45 degrees for too close and +45 degrees for too far). Focus

Error is equal to $(A + D) - (B + C)$, which will be 0 when focus is correct since, with the circular spot, the outputs of all four quadrants will be equal.

6. The disc starts spinning up to 500 rpm and the constant linear velocity (CLV) servo is activated to maintain correct speed. The CLV servo uses a PLL (phase-locked loop) to lock to clock transitions derived from data read off the disc. Data is derived from $A + B + C + D$ (look at Fig. 1).

7. Tracking servo is activated to keep the laser beam centered on the track. With a three-beam pickup, two additional laser spots are projected onto the disc, one in front of and one behind the main beam. Those are offset on each side of the track just enough so that the Tracking Error = $E - F = 0$ when the beam is centered. With a single-beam pickup, similar information is derived using only the main beam; Tracking Error = $(A + B) - (C + D) = 0$ when tracking is correct.

8. Disc directory is read and displayed.

9. Unit shuts down awaiting command or goes into play mode, depending upon how it was activated.

Some of the steps listed above may be performed concurrently. If any of the first nine steps fail, the laser is turned off and the machine will display some kind of error or no-disc message and then return to idle mode, or in the case of a changer, load the next disc and try again.

Validating the Startup Sequence

WARNING: The procedures below may require access to the optical pickup while the laser is powered. The laser diode is infrared (IR), 780 nm, and for all intents and purposes invisible. The only indication of laser output will be a tiny red-appearing dot of light when the lens is viewed from a safe position of at least 6 inches and an oblique angle of at least 45 degrees. Don't be fooled into thinking the laser is weak—the actual beam intensity may be 10,000 times greater than it appears! However, the red dot is a good indication that the laser is at least powered (though not necessarily that it is operating correctly—an IR detector and/or a laser-power meter are really needed for that; see below).

To narrow down possibilities, try following this procedure when the disc is not recognized, but the drawer closes completely:

Start by double checking the drawer closing/opening mechanism. Without

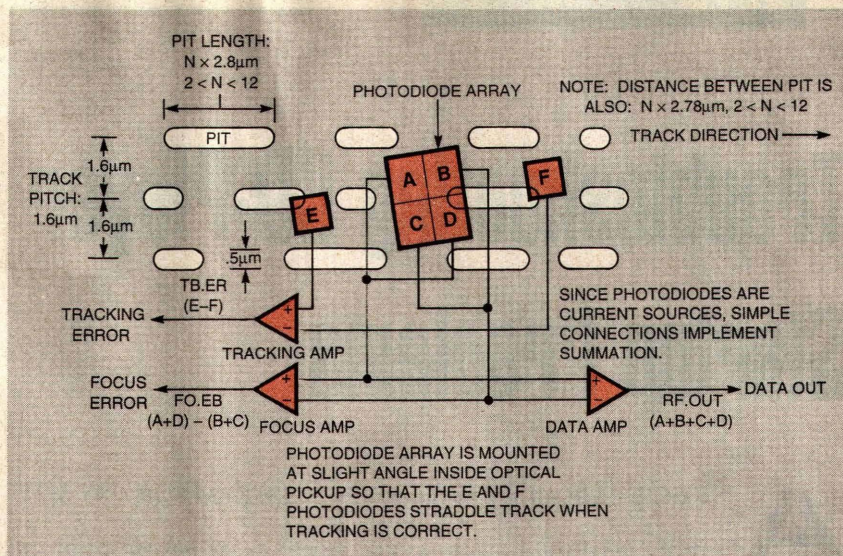


FIG. 1—HERE'S HOW THE PHOTODIODE ARRAY in a unit with a three-beam pickup is arranged. Also shown here is the geometry between the array and the information pits on a disc.

exception, Sony CD players that have belts need them cleaned and eventually replaced. If the drawer does not really close completely, then the disc may not be clamped properly, or other erratic problems could occur.

Once you have verified that the drawer operation is fine, you need to determine that the lens is clean. In general, the lens should look shiny with a blue tinge. Any gunk or crud can and will degrade performance. You may have to remove part of the clamping mechanism to get at the lens. If the lens is not perfectly shiny, clean it carefully as explained previously in this series (see "Service Clinic," July, 1998). A dirty lens—perhaps one not even visibly dirty to your naked eye—can result in any number of startup (or other) problems. Therefore, cleaning the lens should be done before looking for more obscure mechanical or electronic faults.

If lens cleaning does not improve the situation, the next step is to verify that the pickup has reset itself to the inner (center) track of the disc. If necessary, manually move the pickup away from the center by turning the appropriate pulley or gear. If there is a linear actuator or rotary positioner (no gears or belts), just push the pickup gently and see what happens when a disc is loaded. If you are not able to move the pickup from one stop to the other, make sure any shipping lock is disengaged! The pickup should move smoothly toward the center, usually tripping a limit switch and stopping. If there is no movement, if the movement is jerky, or if the pickup gets stuck at some point,

then either lubrication is needed or the motor or drive circuitry may be faulty. Also check for broken or damaged gear teeth, a slipping belt, and misaligned or damaged tracks. Measure the voltage across the motor that moves the pickup. If there is none, or if it is very low (under a volt or so), then there is a problem with the motor, its driver, or the system controller. (We'll discuss more about motors shortly).

Determine if the machine attempts to focus. On portables, you can simply bypass the door interlock to get the operations associated with reading the disc directory to begin (you may also need to press **PLAY**—that need is model-dependent). In some component CD players, a disc actually has to be present to block an optical sensor. You should see the lens moving about 2 mm up and down (at least one of these directions will have a smooth movement) one or two times. If a disc is in place, the lens should quickly stop at the appropriate focus position. Admittedly, however, observing the lens may be difficult or impossible with the disc in place. Dentists are probably good at this!

If the focus action is identical whether a disc is in place or not (it keeps up the search pattern and then gives up), verify that the laser is being powered. In most cases and as outlined above, you will be able to see a tiny spot of red light when the lens is viewed from an oblique angle during the focus search. From a safe distance of at least 6 inches and 45 degrees or more off to one side, you should be

able to see this dim red light in a darkened room while the unit is attempting to focus.

If you do see this, you can assume that the laser is at least being powered, although this is not a sure test for an actual IR laser beam or proper optical-power output. In most cases, however, the red light indicates that the laser is working. An IR detector would confirm at least that there is an IR emission. If there is no dot of red light, then either the laser diode is bad, it is not being powered, or you are not looking from the correct angle.

For a more exact test, you can purchase an inexpensive IR-detector card from most electronics distributors or build your own using a photodiode, a few resistors, a general-purpose transistor, and a standard LED—all powered by a 9-volt battery. Figure 2 shows the circuit for this device. If you do build one, you will also find it useful for testing IR remote controls. (This is the same circuit we showed you when we discussed remote-control repair in the June 1997 installment of this column.)

If the lens is hitting the disc at the top of its excursion, there is a possibility that the spindle table has been pushed too far down, perhaps by something falling on it, for example. A bent shaft and wobbly spindle is also a possibility caused by this kind of damage. This kind of fault is much more likely to occur with a top-loading “boom-box” or portable than to a drawer-loading machine. While the lens hitting the disc with the spindle table set at the correct height is not impossible on some players, it is unlikely. On most lenses, a ring around the outside of the lens itself prevents the critical central area from actually contacting the disc, so accidental contact does not usually damage the lens. However, it can scratch the disc. Similarly, if the spindle is too high, the

lens might not be able to reach high enough to focus properly.

On a player with the height adjusted properly, there is usually about 2 mm between the laser shroud and the bottom of the disc. The spindle height is not super-critical, but if it is way off, you cannot establish proper focus. Incorrectly adjusted focus offset or gain can also result in the search pattern being too high or too low. Either of those can result in inability to recognize discs, noise, or even erratic tracking during play.

Once focus is established (and sometimes concurrent with this operation), the spindle should start to rotate and quickly reach 500 rpm. The speed may be ramped up or controlled in some other search pattern since there is no speed feedback until the data coming off the disc becomes available. A partially shorted drive motor will keep the disc from reaching full speed even though the spindle and disc are turning.

Check the voltage on the spindle motor when it starts. It should reach 2 volts or more. If you read less than this, but not zero, a partially shorted motor or a weak driver is likely. A permanent-magnet-type motor can sometimes be revived by a quick squirt of degreaser through the ventilation holes and/or by **disconnecting** it (very important, or else you could fry your driver circuit and create a new problem!) from the circuit board and applying 9 VDC or so to it with each polarity for a few seconds to spin off the “gunk.” If one of those fixes helps, you can continue to use the player until you get a replacement motor (which might never be needed depending on the severity of the original problem). In some models, the design of the driver circuits is the underlying cause of motor failure, and there are circuit-board changes that would need to be performed to avoid the problem in the future.

If the voltage reads zero at all times, there may be a bad driver, or the machine may not realize that focus was established and is not issuing the spindle-motor start command. The required speed of 500 rpm, just over 8 revolutions per second, can be estimated by using a disc that has a dramatic label, or you can simply put a small piece of tape on the side of the disc that is visible and watch it spin.

Keep in mind that a dirty lens can sometimes create symptoms that are similar to those of a bad spindle motor, so always clean the lens first when servicing a CD player. I almost learned this the hard way.

Once the disc is up to speed, the speed control (constant linear velocity—CLV) and tracking servos will be activated (in some equipment, the tracking servo may have been active all the time), and directory data will be read off the disc. Either of those could be faulty and/or misadjusted, making it impossible to access the disc directory.

During the time that the disc is spinning and the player is attempting to read the disc directory, listen for the “gritty” sound that CD players make during normal operation. It is a byproduct of the focus and tracking servos constantly adjusting the lens position. The rapid movements of the lens produces an audible sound, and its presence is a good indication that the laser is working and that focus is being maintained.

Related Problems

Before we wrap up for this month, Let's look at some related problems.

Pickup attempts to reset past inner track: In this case, the sled motor doesn't stop at the inner track but keeps clicking, clunking, or whirring until the controller gives up and displays an error. This might be due to a dirty, worn, or gummed-up limit switch, bad connections, bad mechanical alignment, broken parts, or logic problems.

Most limit switches are mechanical and easily checked with a multimeter. Those that use exposed contacts can be cleaned and burnished; sealed switches found to be erratic should be replaced, though spraying inside through any openings might help. I have disassembled and cleaned similar type switches (they snapped apart) but it is not fun. Make sure the limit switch actually gets tripped when the sled reaches the area of the innermost track. Check for bad connections between the switch and the

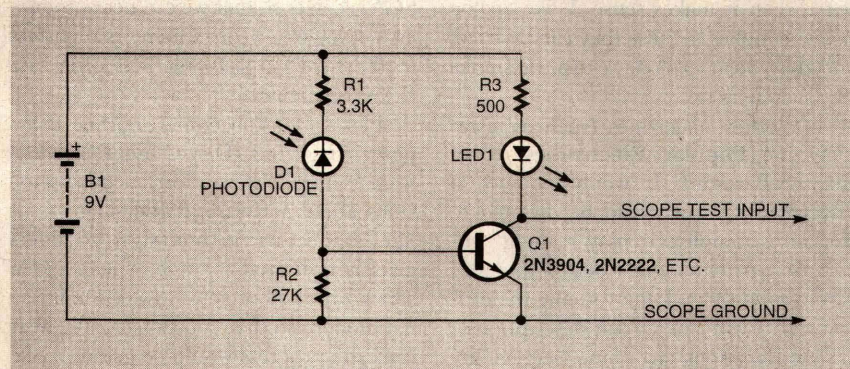


FIG. 2—THIS SIMPLE IR TESTER is a sure way to confirm that the laser is emitting an IR beam. You can also use it to test IR remote controls.

controller.

Logic problems may be difficult or impossible to locate even with schematics. However, you might get lucky as I did once with a CD-ROM drive with a bad 74LS04 in the drawer-switch interface.

Player won't let you go near it and/or use your favorite lamp: Symptoms here could include a player where, if you touch or go near it, the audio becomes noisy, begins to stutter, skips or even stops completely. Note that this might be similar to other tracking (seek and play) problems. However, since a possible cause of this sort of behavior is more general in nature and can affect many different aspects of CD-player operation, these faults are described separately.

One area that may be overlooked as a cause is the shielding of the pickup's low-level signal cable and any metal parts of the optical deck. Those should all be connected to analog ground of the electronics board. If that ground is missing or broken, there can be all kinds of strange symptoms. If you have recently disassembled the unit and it is now behaving in the

manner described, that is a very likely—and, fortunately, easy to fix—possibility. Check for a missing ground strap, jumper, or clip. (Hint: It has probably fallen under your workbench!)

Turning to other possibilities, external interference could make its way into the electronics and produce all sorts of strange behavior. On some poorly designed players—or where you are located close by a radio station—outside interference can get into the player via the audio cables or line cord. A light dimmer on the same circuit might also produce interference via the power supply. Once inside, almost any type of behavior is possible. If your problems seem to depend on the time of day, check out this possibility by relocating the CD player and seeing if the behavior changes substantially. Disconnect the audio cables and see if the unit now displays the disc directory and appears to play properly (try headphones for this, if possible).

It may be difficult to eliminate the effects of the interference without moving away from the radio station or not

using your favorite lamp. However, relocating the CD player or even just its cables and/or plugging it into a different outlet might help. Fortunately, those sorts of problems are not that common.

Wrap Up

Once again we have reached the end of our allotted space. I do hope that you are finding this series both interesting and helpful. Next time we will continue with a look at tracking problems (play and seek). Join me again at that time. In the meantime if you have any problems or questions that just can't wait, go to my Web site at www.repairfaq.org. Questions to me should be addressed via e-mail to sam@stdavids.picker.com.

Important note: I regret that time (after all, there's only a finite number of hours in a day) keeps me from answering mail sent via the postal service, but I will respond to e-mail in a timely manner (often within 24 hours) as long as you provide a valid reply address (e.g., I can hit the reply key for my mail program and not have the e-mail bounce!). See you next time.

EN

LETTERS

continued from page 13

Last year I e-mailed you about my opposition to writers not releasing their source code to allow us to modify their projects to fit our needs. I am not interested in any elaborate kit or series of articles that require me to buy pre-programmed chips from the author to make it work. My exception to this was the Dick Smith ESR meter I bought earlier this year, but the value of the finished project outweighs the locked-in Z80 chip. I have e-mailed the designer of that kit several times, and he is quite a helpful fellow.

I like the new "Prototype" section. I'm glad Covington and Goldwasser are working for you. I like both simple and elaborate project articles, whether they relate to computers or other stuff. I read "Hardware Hacker" or whatever Don calls it now. I gave the series of "Computer Connection" articles on the Palm Pilot to my boss who uses one.

As mentioned in my previous e-mail(s), it really helps to have the schematic on the same page (face) as the circuit description text, rather than flipping back and forth between schematics

and text to find out how it works.

In general, I really like "our" magazine.
RON TESCHER
via e-mail

I am an engineer at a TV station in Atlanta. I read **Electronics Now** for fun. I enjoy seeing how others devise circuits and like to use ideas as starting points for ideas of my own. I enjoy Don Lancaster but miss the heck out of Jack Darr's "Service Clinic." Sam Goldwasser is doing fine, and I like his articles.

I really am not interested in the latest bleeding edge technology, as I see enough "It's digital because we can do it!" Digital is fine; however, I like to see it used when it makes sense. I like analog power supplies because they can be fixed, and they don't explode, chirp, or smoke like switchers do.

Let other magazines (such as sister magazine **Popular Electronics**) cover the newbie stuff. It would be nice if **Electronics Now** could be devoted to the more complex. I enjoy reading construction articles a great deal, although I rarely build them. I enjoy seeing the project schematics and circuit descriptions.

Modifications are fun. Secrets are better. Things like a secret key sequence that activates a hidden stopwatch in a

calculator (HP45 had that) or hidden remote keystrokes that activate maintenance menus in VCRs and TVs.

Tell us things we did not know were possible, like extending a computer keyboard and joystick cord 100 feet with no modifications for extra circuitry other than an extension cord. (I used that trick for my TV station's prompter!)

Tell us that by cutting out a cap or two on a particular AM radio we can increase the fidelity. Or how about a hi-fi AM radio project?

How about modifying a cassette-clock-radio to record at slow speeds to capture entire talk shows to enjoy later? How about a TV Pro-Channel or radio SCA receiver so that we can hear producers talking to TV or radio news reporters in the field? Top 10 markets often use them for cueing.

Please don't become another computer magazine. Discussing PC hardware is fine, but we don't need discussions about software. Little suggestions like connecting an honest-to-goodness chassis-mounted 3-inch speaker (in series with 100 or so ohms) to the internal modem so that you can actually hear the call's progress would be great.

GARY PEARSEY
via e-mail

EN



NEW PRODUCTS

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

Computer Monitor

THE PS790 OFFERS A REVOLUTIONARY 19-INCH (18-inch viewable) "short-depth" display that is ideal for CAD/CAM, graphics, and advanced business users who require a large-screen performance in a small footprint. Comparable to a large-screen performance in a 15-inch (various-viewable) footprint, it's both PC- and MAC-compatible.

With its super-fine 0.25mm dot pitch and Invar shadow mask, the ViewSonic PS790 produces sharp images and easy-to-read text. The advanced SuperClear screen technology enhances brightness up to 30% over conventional CRTs; and it improves color fidelity, creating crisp, color-rich images. A special screen treatment reduces annoying glare and reflection.

Featuring a maximum resolution of 1600×1280 and a high refresh rate of 88Hz at a resolution of 1280×1024 , the innovative short-depth technology of this monitor uses a new type of electron gun with a 100-degree CRT instead of the typical 90 degrees. The wider deflection design creates a smaller beam size that shortens the electron beam distance to produce the 18-inch viewable image. A double dynamic focus system produces better beam-landing accuracy and sharper focus, even in the corners.

Easy-to-use controls, a user-friendly on-screen menu for all screen adjustments, and Plug&Play—which supports Windows 95 requirements for easy configuration and set up, are found on the PS790. The View Match Control allows users to adjust color temperature and individual color intensity for WYSIWYG screen-to-print matching. The monitor has an estimated street price of \$849.

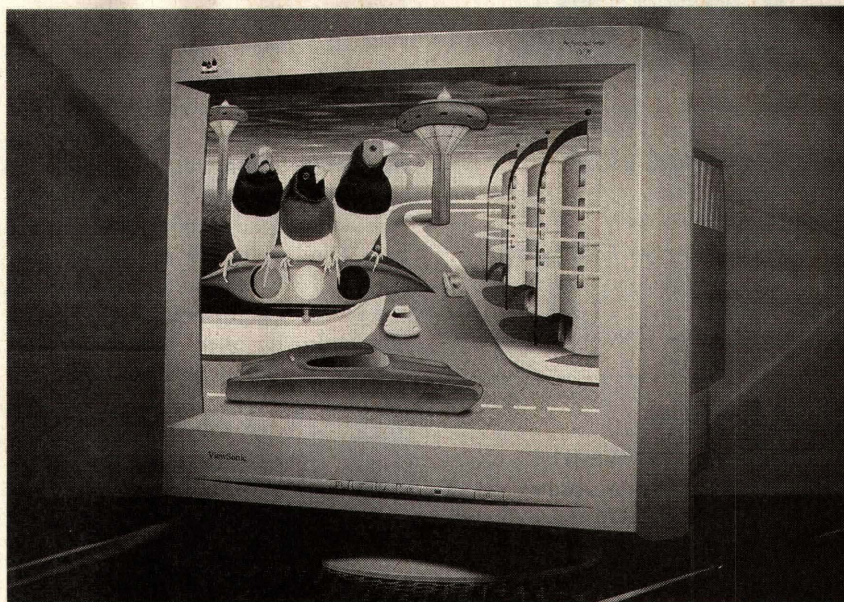
VIEWSONIC CORP.

381 Brea Canyon Road
Walnut, CA 91789

Tel: 800-888-8583 or 909-869-7976

Fax: 909-468-3756

Web: www.viewsonic.com



CIRCLE 20 ON FREE INFORMATION CARD

Image-Editing Software

A COMPLETE IMAGE-CREATION and manipulation program, Paint Shop Pro 5 is designed for use in the office, at home, or on the Web. Developed for consumers looking for advanced functionality and for professionals seeking fast and intuitive tools, Paint Shop Pro 5 includes powerful new editing tools, added file management support, and a streamlined interface that makes importing images into Paint Shop Pro 5 a snap.

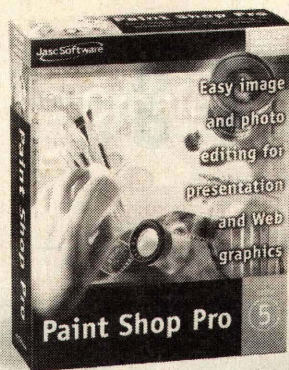
Other advanced features are designed to create and prepare images for use in business presentations, digital photography, the Web, and other platforms. Multiple layer support, layer-sensitive painting, image-compression options, and re-sizing and image-enhancement tools provide control of variations without affecting the whole image. The free-form deformation tool quickly moves, scales, rotates, skews, and adds perspective to individual layers or entire images in real time, while adjustable tools provide precise control over area selection and image cropping. Included with the software is an innovative Web animation

program, Animation Shop.

With its expanded support for over 40 different graphic-file formats, designers can open and save virtually any image file. All the popular Web graphic file formats are supported, including Transparent GIF, PNG, Progressive JPG, and the Kodak FlashPix format. In addition, Paint Shop Pro5 also supports TWAIN scanners, pressure-sensitive tablets, and Photoshop-compatible custom device import and export plug-ins.

The program is designed to meet the needs of the digital photography market as well with a wide range of professional tools that make digital photos look their best. Retouching brushes correct image exposure and adjust saturation and luminance levels and hue. Gaussian blur helps photographers add natural focusing to images, while the clone brush allows users to easily copy and repaint any area of a picture.

Paint Shop Pro5 has a list price of \$99. Upgrades for registered users of previous versions are \$39. An evaluation copy may be downloaded from the Web site listed below.



CIRCLE 21 ON FREE INFORMATION CARD

JASC SOFTWARE INC.

1101 Smetana Blvd.
Minnetonka, MN 55343
Tel: 800-622-2793 or 612-930-9800
Fax: 612-930-9172
e-mail: sales@jasc.com
Web: www.jasc.com

Circuit Simulator

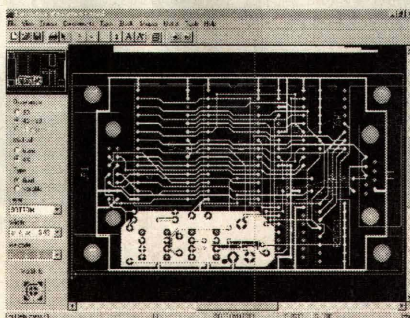
ELECTRONICS WORKBENCH layout—personal edition, a printed circuit board (PCB) design tool that is tightly integrated with Electronics Workbench, Version 5 combines schematic design/capture and board layout in a single package. Both programs (Electronics Workbench plus EWB Layout) sold together are called Personal Design Solution. The complete package now offers designers a fast, convenient way to go from front-end design to back-end layout in a single integrated, comprehensive environment.

The developers have spent time to ensure that all schematic/simulation models are recognized in EWB Layout so users won't experience frustrating "footprint not recognized" errors. A back-annotation feature updates schematics to reflect all reference designator changes made during PCB layout. A netlist-compare function identifies how a schematic has changed since the last time it was saved to PCB, so schematics are

easily identified at the layout stage.

EWB Layout comes with powerful features common to most high-end PCB design tools, including on-line design-rule-check to prevent design errors when they occur—eliminating the need to run batch-check programs to discover costly mistakes or design violations. A "force vectors" feature makes suggestions on where to place components to achieve optimal board placement.

It also contains one of the industry's largest libraries of more than 3500 footprints and a shapes editor to create new footprints in seconds. The program provides all the editing functions needed to create complex boards, including the support of power and ground planes, thermal relief, blind and buried vias, 32 board layers, board sizes of up to 50- by 50-inches, and more. A high-speed, high-completion autorouter offers advanced routing options for optimal and customized per-



CIRCLE 22 ON FREE INFORMATION CARD

formance. Built-in support for all external film production and manufacturing methods includes the ability to transfer design data to Gerber files, Mechanical CAD in DXF formatted files, and Excellon Drill files for numeric controlled (N.C.) drilling machines.

Electronics Workbench—Personal Edition and EWB Layout—Personal Edition sell for \$299 each and run on any Windows 95 or Windows NT computer. If purchased together, the Personal Design Solution sells for \$549.

INTERACTIVE IMAGE TECHNOLOGIES LTD.

111 Peter Street, Suite 801
Toronto, Ontario
Canada M5V 2H1
Tel: 800-263-5552 or 416-977-5550
Fax: 416-977-1818
Web: www.interactive.com

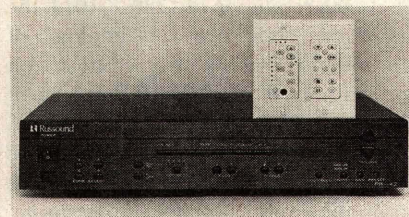
Four-Zone Preamplifier

A VERSATILE FOUR-ZONE A/V preamplifier, the PR-4Z is capable of

handling three audio-only sources and three A/V sources. The unit consists of four fully independent high-quality stereo pre-amps mounted and interconnected on a single (17- by 12- by 3-inch) chassis. It incorporates Russound's proprietary "source lock" and "source link" modes, which provide convenience benefits in party situations or in installations where playback of a single source is wanted.

In source lock, the PR-4Z automatically feeds the source selected from zone 1 to all other zones. The ability for each zone to change sources is locked out in this mode, while each zone still maintains control of its own volume. This allows a single source to be heard in the den, dining room, and patio—all at individually adjusted volumes. The source link mode allows source selection from any keypad in the system. The host, for instance, would not have to return to zone 1 to change the source from tuner to CD.

In addition to switching between the audio and A/V sources, each of the four independent pre-amps provides volume, bass, treble, and loudness controls for each zone. Zone memory allows preferred playback characteristics to be programmed for each zone. For complex systems, up to four PR-4Zs can be daisy chained, creating a fully integrated 16-zone system with each of the zones maintaining independent stereo operation.



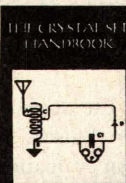
CIRCLE 23 ON FREE INFORMATION CARD

A system-wide page can be activated via an optional push-to-talk keypad or through the paging output of a telephone system, and the volume can be user-adjusted. The PR-4Z can also accept "paging" from door bells, security systems, and other systems. The page overrides all other sources for every zone; and when it is completed, each zone reverts to its previous status. Russound's PR-4Z four-zone A/V preamplifier has a MSRP of \$1850.

RUSSOUND

5 Forbes Road
Newmarket, NH 03857
Tel: 800-638-8055
Fax: 800-915-5519
Web: www.russound.com

Get your copy of the CRYSTAL SET HANDBOOK



Go back to antiquity and build the radios that your grandfather built. Build the "Quaker Oats" type rig, wind coils that work and make it look like the 1920's! Only \$10.95 plus \$4.00 for shipping and handling. Clagck Inc., P.O. Box 4099, Farmingdale, NY 11735. USA Funds ONLY! USA, Canada and Overseas. NY State residents add local sales tax. MA01



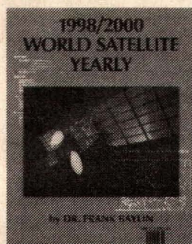
NEW LITERATURE

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

The 1998/2000 World Satellite Yearly

by Dr. Frank Baylin
Baylin Publications
1905 Mariposa
Boulder, CO 80302
Tel: 303-449-4551
Fax: 303-939-8720
Web: www.baylin.com

\$90, plus \$5 S&H in U.S. and Canada; air shipping elsewhere is \$40 per book



CIRCLE 338 ON FREE INFORMATION CARD

This 864-page, 8 1/2- x 11-inch, reference book, provides the up-to-date information necessary to determine the satellite programming available at any receive site on the globe as well as the equipment, including satellite dish and associated electronics, required to receive those signals.

Written for the educated layman, the book is divided by easy-to-use tabs into four sections: technical, satellite, programming, and reference materials.

The technical section explores the function and use of broadcast satellites. It describes how to read footprint maps, outlines the components of a satellite earth station, and discusses techniques required to size and to aim satellite receive dishes and LNBS. In addition, this section covers broadcast formats, as well as an overview of audio transmission methods.

The latest details about compressed digital video and audio methods and the role of the MPEG2 standard are outlined, including an overview of recent developments in HDTV. Scrambling and encryption techniques; worldwide allocations of communication frequencies; spacecraft, systems, and channel frequency layouts; and mobile satellite-reception systems are presented.

The programming section lists the video programming available on all the

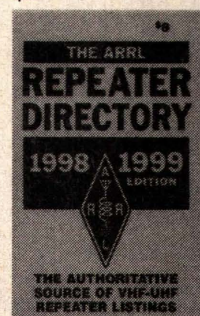
world's geostationary broadcast satellites with details that include program name, polarity, frequency, bandwidth, encryption method and language. The 500-page satellites section presents a full data page on each of the world's operational geostationary broadcast satellites in a standardized and comprehensive format.

Also included is a complete directory of satellite programmers, operators, and manufacturers, as well as earth station component manufacturers. Complete and detailed tables, graphs, and equations are found in each chapter.

The ARRL Repeater Directory 1998-1999 Edition

Edited by Jay Mabey, NU0X
American Radio Relay League
225 Main Street
Newington, CT 06111
Tel: 800-243-7767
Fax: 860-594-0303
e-mail: itardette@arrl.org
Web: www.arrl.com

\$8



CIRCLE 339 ON FREE INFORMATION CARD

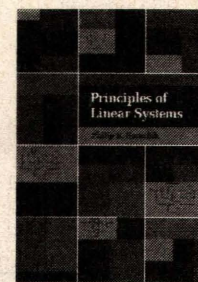
Every new edition of this pocket-size directory provides current frequency and mode information for repeaters throughout North America and, where available, the Caribbean, Central and South America, Pacific Islands under U.S. jurisdiction,

Europe, and other areas. There is also information for contacting Frequency Coordinators and ARRL officers. In addition, the introductory chapters provide guidelines for repeater operating practices, autopatch guidelines, an explanation of notes and special features used in the directory, a discussion and listing of band plans, as well as repeater lingo/novice hints.

There have been some changes to the contents of the Repeater Directory. Updated information on all clubs is now found on the League's Web page: www.arrl.org. The digital listings that were previously included are now on the Web site of the Tucson Amateur Packet Radio Corp. (TAPR): www.tapr.org/directory.

Principles of Linear Systems

by Philip E. Sarachik
Cambridge University Press
40 West 20th Street
New York, NY 10011-4211
\$34.95



CIRCLE 340 ON FREE INFORMATION CARD

This textbook is invaluable for graduate students of aeronautical, electrical, and mechanical engineering, or anyone who wants a background in the fundamentals of linear systems and modern control systems. It concentrates on explaining state-space methods that form the basis of modern control theory, and how those methods are useful in the analysis of linear multiple-input, multiple-output dynamic systems.

Continuous-time and discrete-time systems are treated in parallel, throughout the book, as are time-varying and classical time-invariant systems, highlighting their similarities and differences. The first chapter presents the basic concepts and definitions, followed by a detailed discussion of state equa-

BooksNow

To order books in this magazine or, any book in print. Please call anytime day or night: (800) BOOKS-NOW (266-5766) or (801) 261-1187 ask for ext. 1454 or visit on the web at <http://www.BooksNow.com/electronics-now.htm>.

Free catalogs are not available.

tions of finite dimensional systems and their solutions. Then, the principles of time-domain and frequency-domain analysis are covered, as are the properties and applications of the Z-transformation. Both the controllability and observability of linear systems, as well as their stability, are examined in detail.

A useful tutorial review of the key results from matrix theory and linear algebra is given in the Appendix. In addition to illustrative examples, which are completely worked out, numerous problems are available at the end of each chapter.

Radio Components Handbook for the Radio and Electronics Technician: Theory of Components, Book I

by Guido Sliva, I2EO

MFJ Enterprises, Inc.

P.O. Box 494

Mississippi State, MS 39762

Tel: 800-647-1800 or 601-323-5869

Fax: 601-323-6551



CIRCLE 341 ON FREE INFORMATION CARD

\$29.95

Designed for engineers, technicians, amateur radio operators, and students, this book presents direct and clear needed information about inductors, loops, transmission lines, capacitors, and

more. The author, who is himself an amateur-radio operator, emphasizes the building of circuits.

Everything from the basic theory of radio components to plans for accurate

test instruments you can build, plus numerous circuit examples, is provided in this comprehensive guide for ham-radio operators and experimenters. The descriptions for designing and building parts and circuits are written in an easy-to-understand style. Over 100 full-page graphs are included, and formulas and examples are included to illustrate concepts or design questions.

Among the topics discussed are components, circuits, transmitters, power supplies, and transmitting loops and filters. The handbook also covers important data on many different component types. Instructions are given on how to build and use inductors of all types.

Easy PIC'n: A Beginner's Guide to Using PIC16/17 Microcontrollers

by David Benson

Square 1 Electronics

P.O. Box 501

Kelseyville, CA 95451

Tel: 707-279-8881

Web: www.sq-1.com

\$29.95



CIRCLE 342 ON FREE INFORMATION CARD

The PIC16/17 from Microchip Technology, Inc. was originally designed to be a very fast I/O controller. The PIC16F84 microcontroller is unique because its program memory is

made using FLASH technology. It can be programmed, tested in-circuit, and reprogrammed if necessary in a few minutes.

Intended to help the beginner with understanding and application of the PIC16/17 line of microcontrollers, this book uses a hands-on approach. There are many examples given throughout, all of which may be demonstrated using a very simple demo board—a project explained at the beginning of the book.

The author uses the MPASM assem-

bler from Microchip Technology in the book, because, as he explains, it is in common use; is free from the manufacturer; is included in MPLAB, a popular Microchip development software package; and examples on the Internet are written in MPASM. The examples of assembly-language programs that are presented range from a simple one to turn on LEDs to more complex ones for timing and for event-counting. Writing programs is covered in-depth. The use of flow charts as an aid to visualizing what a program does is emphasized.

Data Acquisition and Communications Catalog

B&B Electronics Manufacturing Company

707 Dayton Road

P.O. Box 1040

Ottawa, IL 61350

Tel: 815-433-5100

Fax: 815-434-7094

e-mail: catrqtst@bb-elec.com or sales@bb-elec.com

Web: www.bb-elec.com

Free



CIRCLE 343 ON FREE INFORMATION CARD

This 52-page catalog shows solutions to computer serial-port connection problems. Their port-mounted converters allow incompatible interfaces to be connected, and they communicate at distances up to 4000 feet.

New product highlights include 9-pin port-powered converters with SD control that change TD and RD RS-232 lines to balanced half-duplex, two-wire RS-485 signals; RS-232 asynchronous to synchronous converters that can interface with marine navigation equipment; PCI bus Ethernet cards; port intelligent controller cards; and software programming tools, such as CommLib 5.2 and ArchiveLib 2.12. Also featured are communications and PC/MIA cards; fiber-optic products; data-acquisition modules; optoisolators, surge protectors, and security devices; and digital multimeters designed to read low-voltage communications-line signals, some with built-in memory and the ability to download to a PC.

In addition to product descriptions, the catalog presents technical data and application information.

EN

POPTRONIX®

Online Edition

We're on the web **FREE**

<http://www.poptronix.com>

WE'RE WITH YOU EVERY DAY
24 HOURS A DAY! DROP IN!
WE'D LOVE TO HAVE YOU VISIT!

BooksNow

To order books in this magazine or any book in print. Please call anytime day or night: (800) BOOKS-NOW (266-5766) or (801) 261-1187 ask for ext. 1454 or visit on the web at <http://www.BooksNow.com/electronicsnow.htm>.

Free catalogs are not available.

BURN PIC MICROCONTROLLERS WITH A "NO PARTS" PIC PROGRAMMER

When creating and designing a new electronics project, the current trend is to try to keep the descriptive terms "low-cost," "full-featured," and "ultra-compact" in the top slots in a list of features. That used to be hard to do. Fortunately, over the last several years, designing a project with those attributes has become much easier thanks to the development of programmable devices such as the PIC microcontroller family from Microchip Technologies. Looking over the last year's worth of construction articles that have been published in **Electronics Now** shows just how commonplace those microcontrollers have become.

Unfortunately, some sort of programming device is needed to "burn" the software into those programmable chips. The cost of such a device could easily wipe out any savings from using a microcontroller in a project—until now.

Obviously, the PIC programmer presented here needs some parts in order to build it. The nicest feature of the unit is that it needs no specialized parts, and it's a very simple circuit. The unit can be built in about an hour with parts from either your junk box or the nearest RadioShack store. Connect it to the printer port of any handy PC (the port need not be bi-directional), run the free software, and you can get started programming PIC16F84, 16F83, and 16C84 microcontrollers



*Now you can "magically"
create your own custom
PICs with this simple
programmer.*

MICHAEL A. COVINGTON

immediately. With an adjustable power supply, you can even do production-grade work.

What's a PIC? A PIC, like most microcontrollers, is a tiny computer with CPU, ROM, RAM, and I/O circuits all on one chip. Microcontrollers are the fastest-growing segment of the electronics industry; the average home now contains about 100 of them in

everything from microwave ovens to wrist-watches.

Many microcontroller applications don't involve computing, at least not as you'd normally think of it. A microcontroller is best thought of as an IC that you can customize by writing a program in assembly language. You then download the program into the ROM area of the microcontroller, and the microcontroller becomes a custom IC. Sometimes the program is designed to be little more than a logic gate or an oscillator, but what's important is that it does exactly what you tell it to do.

Among the low-end microcontrollers, the PIC family from Microchip, Inc. is especially popular because of their simplicity and low cost. Additionally, much of the software used to create the program code needed for programming PICs is available free for downloading from Microchip's Web site (www.microchip.com).

Of the various types of PICs that are available, the 16F83, 16F84, and 16C84 are probably the easiest to work with. Those particular models are the ones that our programmer supports. They cost less than \$6 each, and their ROM is electrically erasable so that you don't need an ultraviolet light to erase and reprogram the devices.

The 16F84 is the most popular of the three—it has 68 bytes of RAM and 1024 words of program memory. The program memory is a "flash"

EEPROM that can be rewritten over a million times. Any stored information will be preserved for over 40 years without any power. The 16C84 is very similar but uses an older type of EEPROM. The 16F83 can be considered a "little brother" in that it has only half as much memory; on the plus side, it is somewhat lower in cost.

Unlike most microcontrollers, those PICs don't require quartz crystals or resonators for their clock; you can use a resistor and capacitor as the oscillating elements. They also do not need a tightly-regulated power supply. The supply voltage for the 16F84 can be anywhere from 4 to 6 volts. An extended-voltage-range version can work with the supply being as low as 2 volts. There are 13 input/output pins, each of which can be set individually to be either an output or an input—with or without a built-in pull-up resistor.

The "No Parts" Programmer. Programming the above-mentioned PIC chips is unusually simple. Apply 5 volts to pin 14 (with pin 5 connected to ground) and raise the voltage on pin 4 to between 12 and 14 volts. The data is then clocked in one bit at a time through pins 13 and 12. The data itself is sent to pin 13. Once the bit is ready, the voltage on pin 12 is raised to 5 volts for at least 0.1 microseconds before being lowered back to ground. The data stream going into the chip contains both commands that specify the various steps in the programming process and the data that will be stored in the chip's ROM. To verify that the PIC was programmed correctly, the PIC can also send its contents back out through pin 13. For those who are interested in the full technical details on programming PIC chips, specifications for programming and verification can be found on Microchip's Web site (www.microchip.com).

The schematic diagram for the "No Parts" PIC Programmer, as shown in Fig. 1, is as simple as the programming process that it supports. The circuit is designed to plug into the printer port of any PC. The programming data and clock signals are applied to IC1—the PIC being programmed—through R2 and R3. Diodes D1, D2, and resistor

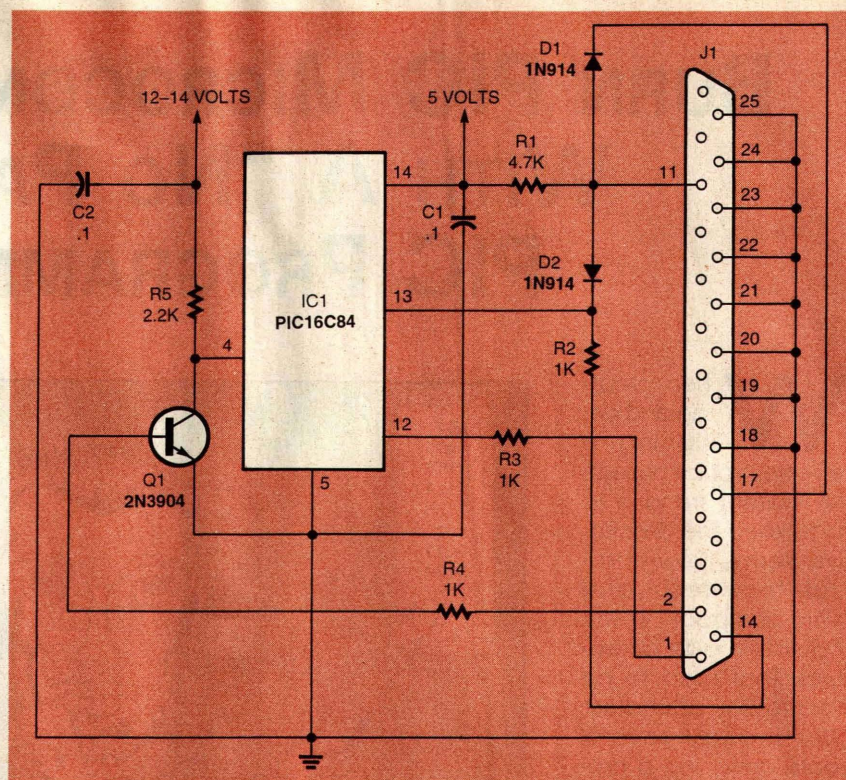


Fig. 1. The "No Parts" PIC Programmer is a simple circuit that attaches to the printer port of a PC. It can program, verify, and erase 16F84, 16C84, and 16C83 PIC chips.

R1 let pin 13 of IC1 be used as both an input for programming and as an output for verification. When pin 17 on the printer port is high, the PC can read data from pin 13 of IC1 through pin 11 of the printer port. In that mode, R1 and D2 provide pull-up for the data signal. When pin 11 of the printer port is low, D1 conducts. The anode of D2 is grounded, blocking current flow. The PIC chip is then free to receive data from pin 14 of the printer port. The connection that D1 creates between pins 11 and 17 on the printer port lets the programming software detect if the programmer is connected to the printer port.

Capacitors C1 and C2 eliminate noise in the DC power lines. The programming voltage is switched by Q1.

Two power supplies are needed to run the "No Parts" PIC Programmer: 5 volts and 12-14 volts. If you're doing any experimentation with digital circuits, you probably already have a power supply available that provides those voltage levels. Obviously, that supply can also be used for the programmer. Another alternative is to "borrow" the voltages from a diskette-drive power

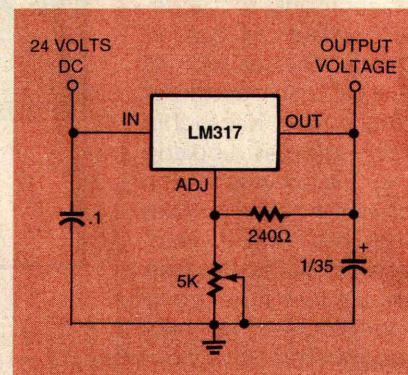


Fig. 2. With some testing, this power-supply schematic can be used with the "No Parts" PIC Programmer. By using two circuits, you can have an adjustable 5-volt power supply for production-grade verification of programmed PICs.

connector inside the PC. Make sure that the 12-volt line is not less than 12.0 volts. If you use that power source, you should be comfortable opening up your PC and working with the internal components. If you aren't and don't know someone qualified that can help you, you can use the power-supply schematic shown in Fig. 2. That schematic is taken from the data sheet for the LM317 adjustable-voltage regulator, and is provided here only for experimentation purposes. The complete data sheet for the LM317 is available

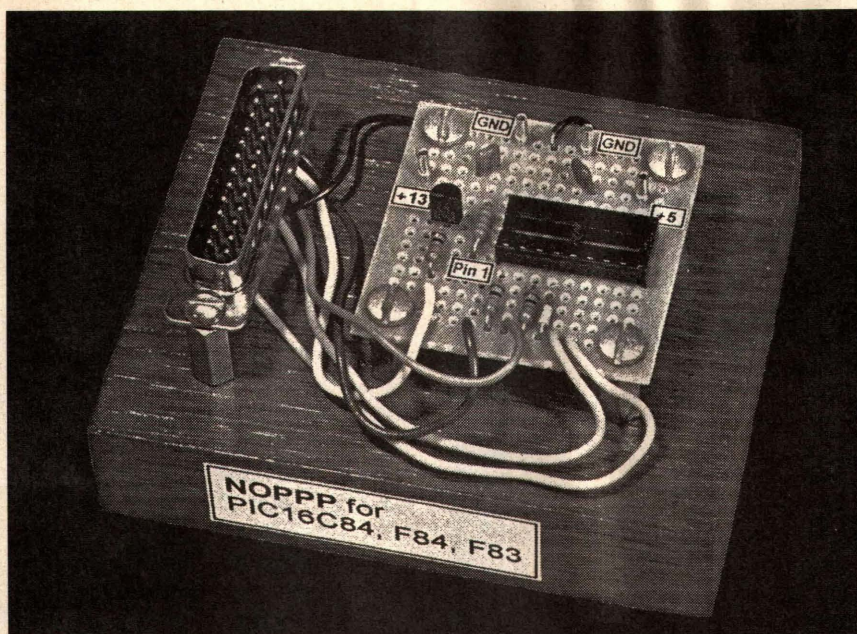


Fig. 3. The assembled "No Parts" PIC Programmer can be as simple or as fancy as you want.

from National Semiconductor's Web site (www.national.com).

The programmer's circuit is so simple, it can be easily built on a piece of perfboard using standard construction techniques. A zero-insertion-force (ZIF) socket can be used at IC1 as a professional touch but is not required. With a suitable adapter, surface-mount PICs can also be programmed. The packaging of the unit can be as simple or as fancy as you want. The author's prototype, shown in Fig. 3, was mounted on a hardwood base that was stained and varnished for a "home-built-with-old-world-pride" look. Mounting the cable connector separately as shown makes the "No Parts" PIC Programmer easy to use—simply connect it to the PC's printer port with a suitably-long 25-conductor cable.

PIC Programming. The easiest way to learn to use the "No Parts" PIC Programmer is to actually write a simple program and burn a chip. Learning about the programmer that way is also a good way to test out the hardware and software.

For example, let's look at the simple problem of building an LED "light chaser," a circuit that will light up one LED after another, in sequence, over and over. You could do it with three ICs: an oscillator, a binary counter, and a decoder/demultiplexer. A PIC version of the circuit is

shown in Fig. 4.

Although that circuit might cost a bit more than a traditional digital circuit, it is certainly smaller in terms of the physical size of the board needed to hold all of the components. However, there is another feature to using a PIC for such a mundane task—intelligence. Different patterns can be generated or multiple patterns can be selected with the addition of a simple switch arrangement. With discrete components, the circuit would have to be scrapped and re-designed to accommodate changes like those. With a PIC, it is a simple matter of modifying the program, erasing the PIC, and re-programming it.

Let's get back to our example. The program itself, written in PIC assembly language, is shown in Listing 1. The most important part of any program is the documentation. If you leave notes in the program, you'll remember what you were trying to do if you have to review the program at some time in the future. In the program listing, those notes are any lines that start with a semicolon. Those lines will be ignored by the software, called an *assembler*, that will turn the text in the program into the binary numbers that the PIC recognizes as instructions.

The first three instructions, *processor*, *include*, and *_config*, are instructions to the assembler. The first instruction tells the assembler to use

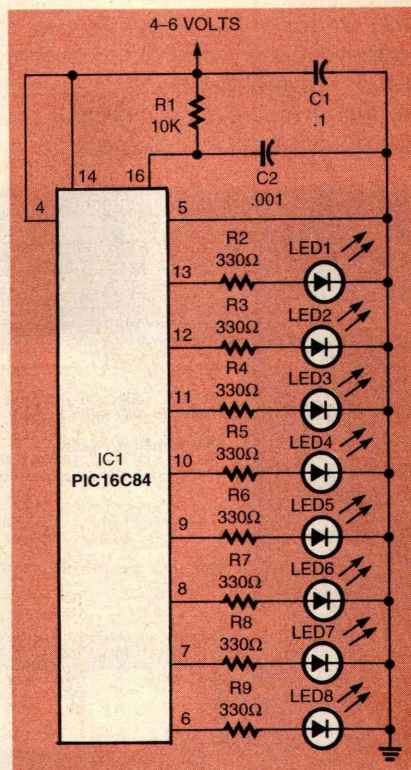


Fig. 4. Here is a simple PIC circuit that, with the accompanying software, flashes the LEDs in a "chaser" sequence.

PARTS LIST FOR THE "NO PARTS" PIC PROGRAMMER

SEMICONDUCTORS

IC1—PIC16C84, PIC16F84, or PIC16F83 microcontroller, unprogrammed
D1, D2—1N914 silicon diode
Q1—2N3904 NPN silicon transistor

RESISTORS

(All resistors are 1/4-watt, 5% units.)
R1—4700-ohm
R2—R4—1000-ohm
R5—2200-ohm

ADDITIONAL PARTS AND MATERIALS

C1, C2—0.1-μF ceramic-disc capacitor
J1—DB25 male connector
Socket for IC1, 25-conductor cable, hardware, etc.

16F84 instructions. The second instruction says to include a set of predefined constants in a file called P16F84.INC. Finally, the third instruction sets various configuration bits in the PIC to turn some hardware features on or off. In this example, the chip will be using its RC oscillator, its "watchdog" timer will be turned off, and the automatic power-up reset timer will be turned on. That way, the

PIC will reboot whenever power is applied, but it won't automatically reboot several times a second. That feature may be used if there is the possibility of the PIC program "lock-

ing up" or for a special timing arrangement in a control application.

It is important to use the `__config` instruction in any programs used

with the "No Parts" PIC Programmer. The assembler program will not be doing the actual programming—it will only be creating a file with the numbers that will be transferred to the PIC chip as a second step.

The two `equ` instructions reserve memory space in the PIC's RAM for two variables, which we'll be calling "J" and "K." It is just like declaring variables in BASIC, only we need to say which physical RAM locations will be used. In this case, those locations are (in hexadecimal numbering) 1E and 1F. Those locations will be used to store counters to keep track of how many times a loop has been repeated.

The `org` instruction tells the assembler that the program starts at location 0 in program memory and that the actual program is next.

The first real PIC instruction is a `movlw` instruction that clears the working register (called W). That number is then copied into the TRIS control register for port B, setting pins 6–13 to output pins instead of input pins. Next, the program puts binary 00000001 into the W register and copies it to Port B. That lights the LED connected to pin 6. But before you have time to actually see the LED come on, the program executes an `rlf` instruction that rotates the contents of Port B to the left, changing the data to 00000010. That will light the second LED attached to pin 7 instead. Repeating that instruction will give 00000100, then 00001000, and so on, making the LEDs flash in a marching pattern.

In between rotations, the program needs to wait about ½ second so that the action isn't too fast to see. That's why we have a delay loop in the program. It stores the decimal number 50 in memory locations "J" and "K," using the `decfsz` instruction to count down from 50 to 0.

Conditional instructions on the PIC are somewhat unusual, and `decfsz` is no exception. It stands for "Decrement and skip next instruction if zero." Translating the program into English, the instructions

```
kloop:  decfsz    K,f
        goto     kloop
```

mean "Subtract 1 from variable K,

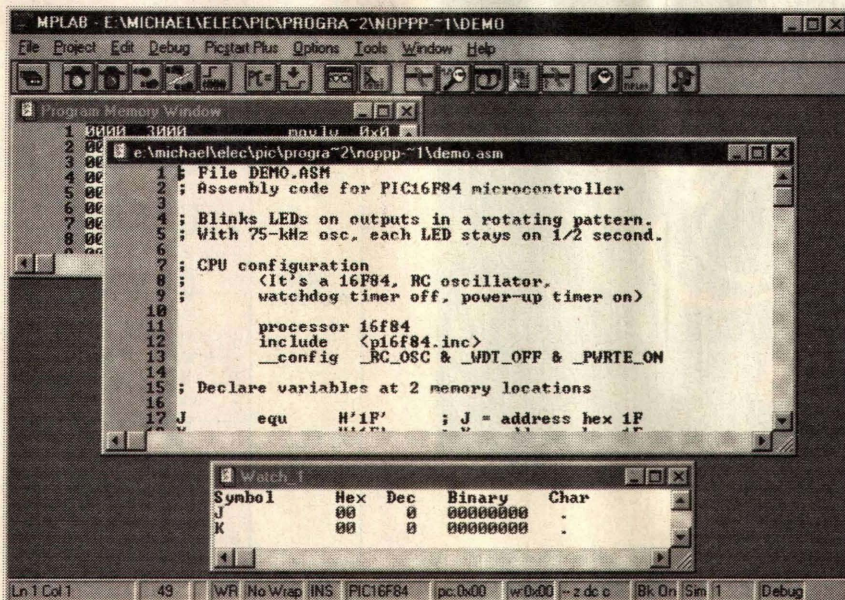


Fig. 5. MPLAB software, free from Microchip, lets you assemble and test PIC programs.

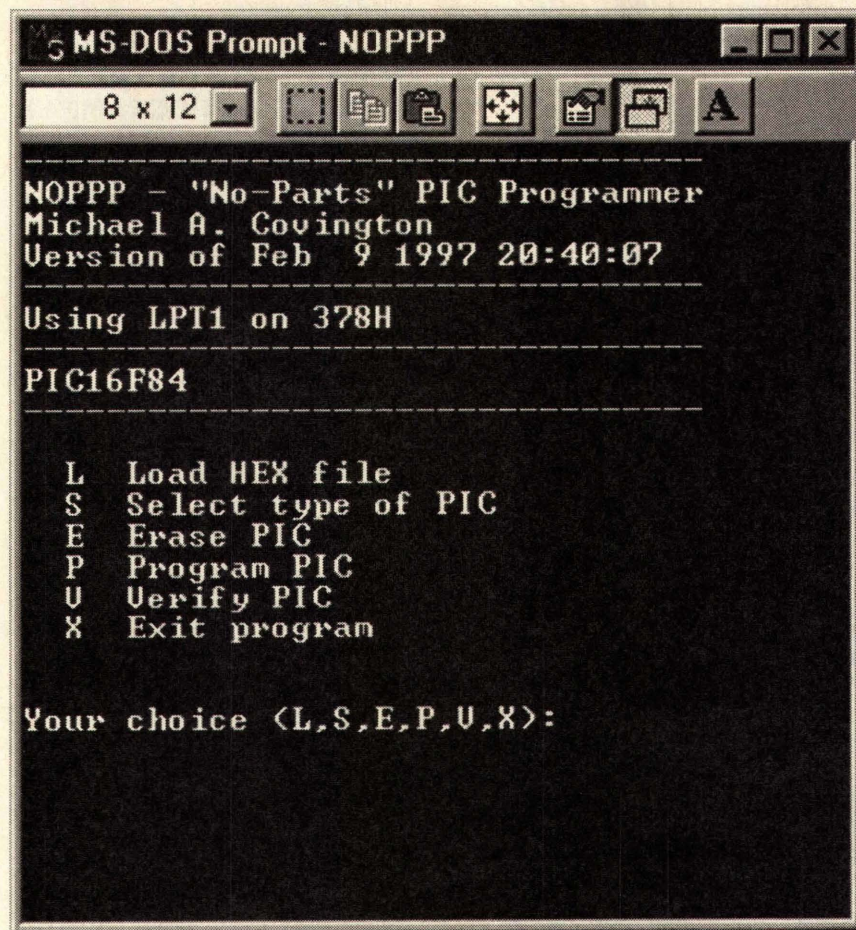
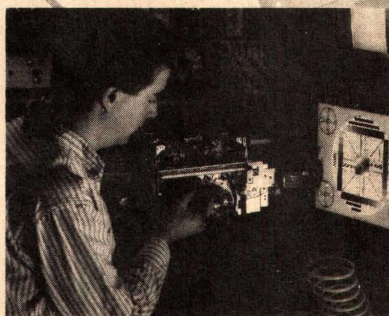


Fig. 6. The NOPPP software does the actual work of "burning" PICs. Shown here running under Windows 95, it also runs under DOS, Windows 3.1, and OS/2.

The Four-Year Electronics Degree Program That Really Hits Home!

Bring The Technology Home With A Bachelor Of Electronics Engineering Degree. No Hassles. No High Cost!



Now's the time to prepare for a profitable career.

We've lowered the cost of higher education.

It's true! You can earn a four-year Bachelor of Electronics Engineering Technology degree today ... and prepare yourself for a high-paying electronics career ... without quitting your job or ever leaving your home. Because World College, an affiliate of the Cleveland Institute of Electronics, offers you the total flexibility of independent study programs proven effective for people like you who truly want to succeed! World College independent study lessons help you build valuable skills

**Mail/Fax Today
or Call
1-800-696-7532**

step-by-step, and expert instructors are personally available to you with a toll-free call. What a way to earn an education!

A world of opportunity.

Where is your career headed? With a four-year bachelor's degree from World College, you call the shots, choosing from incredible, high-paying opportunities in electronics, telecommunications, computer, electrical power, and many other growing fields.

World College gives you the skills, the knowledge, the power to take advantage of your best opportunity in electronics. And you can do it all at your own pace!

Without leaving home.

World College continually works to provide its students with the most advanced education tools. From the latest equipment and reference books to breakthrough computer-simulated experiments, students are exposed to the latest technological advancements.

All the equipment, parts, and software you need are included in your affordable tuition, including more than 300 hands-on lab experiments you can complete in your home.

Choose your own pace.

Earn your bachelor's degree on your time — and at your pace — because you pay tuition to World College only as you complete the upper-level semesters close to graduation. The faster you make it through, the less you pay. So you have an incentive to make your future happen quickly — yet the freedom to choose your own pace!

Send today for your FREE course catalog — and give yourself that future you've always wanted — with an electronics degree education from World College.



Take charge of your future in electronics.

Four Powerful Reasons To Connect With World College Today:

- 1. Earn your four-year degree!**
- 2. Self-paced training!**
- 3. Independent study in your home!**
- 4. Expert instruction!**

Give Me The Power!

Send me a FREE World College course catalog today!



(Please Print Neatly)

Name _____

Address _____

City _____

State, Zip _____

Phone () _____

Age _____

For Faster Service, Call

1-800-696-7532,

or

1-757-464-4600

Fax this coupon to

1-757-464-3687



Lake Shores Plaza
5193 Shore Drive, Suite 105
Virginia Beach, VA 23455-2500

www.cie-wc.edu

WAE74

LISTING 1

```
; File DEMO.ASM
; Assembly code for PIC16F84 microcontroller

; Blinks LEDs on outputs in a rotating pattern.
; With 75-kHz osc, each LED stays on 1/2 second.

; CPU configuration
;      (It's a 16F84, RC oscillator,
;      watchdog timer off, power-up timer on)

processor 16f84
include    <p16f84.inc>
__config _RC_OSC & _WDT_OFF & _PWRTE_ON

; Declare variables at 2 memory locations

J      equ    H'1F'      ; J = address hex 1F
K      equ    H'1E'      ; K = address hex 1E

; Program

org     0              ; start at address 0

; Set port B as output and initialize it

movlw   B'00000000'    ; w := 00000000 binary
tris    PORTB          ; port B ctrl register := w
movlw   B'00000001'    ; w := 00000001 binary
movwf   PORTB          ; port B itself := w

; Rotate the bits of port B leftward

mloop:  rlf            PORTB,f

; Waste some time by executing nested loops

movlw   D'50'          ; w := 50 decimal
movwf   J              ; J := w
jloop:  movwf   K        ; K := w
kloop:  decfsz  K,f       ; K = K-1, skip next if zero
        goto   kloop
        decfsz  J,f       ; J = J-1, skip next if zero
        goto   jloop

; Do it all again

goto    mloop

end
```

and if the result is zero, skip the goto instruction." Normally, the result is not zero and the goto part of the instruction is not skipped. Instead, the loop executes repeatedly until K reaches zero. As you can see, if you like double negatives—or rather, *don't not* like double negatives, you'll love programming PICs. The actual program uses two loops, one nested within the other.

Finally, *goto mloop* sends execution back to the beginning of the program. The *end* instruction is not a CPU instruction; instead, it tells the

assembler that the program is over.

The 16F84 has 35 different CPU instructions. As you can see from the simple program we just created, you don't have to master all of them in order to write useful programs.

Compiling Programs. At the Microchip Web site, you can get data sheets, application notes, and best of all, MPLAB, which is a full-featured development program for compiling and testing PIC programs. It is designed to run under Microsoft Windows. A sample screen shot

seen in Fig. 5 shows our demo program being edited. The MPLAB software lets you edit assembly-language programs (also called *source code*), assemble them into object code, and then step through the resulting binary code to see what it will actually make the microcontroller do. That way, you can spot any logical errors in your programming before you actually commit any code to hardware.

The Microchip software is well documented on its use. We are going to be using MPLAB to create an object-code file from the source-code text we typed in from Listing 1. Be ready for an error message when compiling the program. MPASM will complain mildly that you're not supposed to use the *tris* instruction. Microchip has dropped support for that instruction and some future PIC processors might not support it. A nice feature of the PIC from a software point of view is what is called *source-code compatibility*. If your design outgrows the resources of the chip that you started with, you can use another chip with more resources without having to rewrite the program from scratch. For our purposes, using the *tris* instruction on the 16C84, 16F84, and 16F83 works fine. Besides, the alternative way of setting up Port B for output is much more complicated.

"Burning" a PIC. A second piece of software is needed for actually using the "No Parts" PIC Programmer. That software is available at the Gernsback Web site (<ftp://ftp.gernsback.com/pub/EN/nopppp.zip>). That MS-DOS program runs well under Windows 3.x or Windows 95. If, however, you are running it under Windows 3.1, it will work best if you run the application "full screen" instead of in a window. Timing is critical for the programming pulses, and full-screen DOS applications get full control of the computer. If for some reason you have difficulty running the NOPPP program under Windows 3.1, try exiting to a DOS prompt and run it from there. You can even run the program under OS/2; if you do, be sure to set the HW_TIMER to "on" in the DOS settings for the program.

The first step is to connect the "No Parts" PIC Programmer to the PC's

printer port and start the NOPPP program without any power connected to the programmer. If the 5-volt line is grounded, the software will not be able to detect D1, and will assume that the programmer is not attached to the printer port.

If all is well, you should see a screen similar to the one shown in Fig. 6. The menu of choices is self-explanatory. In general, you would want to load an object-code file (with a .HEX extension in the filename) into memory, select the type of PIC that you will be programming, program the part, and then verify that the code was programmed into the chip correctly. You can also erase a PIC that has already been programmed for re-use or updating of the programming. One note of caution: you should never insert or remove a PIC from the programmer while the power to the programmer is on. When programming a PIC, the software will tell you what to do and when to do it.

Since the programmer software requires some tricky timing, it was written to run as a DOS program. Recall that the clock pulses for programming the PIC have to last at least 0.1 microseconds. In practice, they are somewhat longer in order to overcome any signal "bounce" in the cables. However, they shouldn't be too long or the programming process will go too slowly. It is also important that the pulse timing not depend on the speed of the computer's CPU. Because the software was written with that in mind, it will run on any IBM-compatible from a 4.77-MHz XT up to the latest Pentiums.

To achieve that, the programmer software uses one of the timers built into the PC motherboard. One of the PC's built-in timers produces an interrupt 18.2 times per second (65,536 times in a 24-hour day). That timer is used to update DOS's time-of-day clock, and some software uses it to manage any concurrent processes. However, 18.2 times per second is far too slow to be useful for PIC programming. The software instead uses the other timer that is normally used to control the tones in the internal speaker. The time delay available from that timer can be set to 25 microseconds, so that even on the

fastest Pentiums, the programming pulses are not too short. There will be some unpredictable software overhead, so the pulses will come out a bit too long on the slowest PCs, but not long enough to do any harm.

Production-Grade Programming.

As cheap and as simple as it is, the "No Parts" PIC Programmer can qualify as a production-grade programmer for confirming the reliability of your programmed PICs. How? By varying the 5-volt supply over the entire specified range while verifying the PIC. To do that, you'll of course need an adjustable 5-volt supply. First program and verify the PIC with the 5-volt supply set to 5.0 volts. Next, set the 5-volt supply to 6.0 volts and verify again. Finally, verify the PIC a third time with the 5-volt supply set to 4.0 volts.

Why does that guarantee reliability? Because the main source of unreliability in EPROMs of any type is that some of the cells might not be completely programmed or completely erased. If a particular location is only "half on" or "half-off", it might read correctly for a while but then shift to the wrong value with age or changes in the supply voltage. The result is that the ROM contents change unpredictably and the microcontroller fails during use. By shifting the 5-volt supply voltage up and down, you change the threshold voltages that define 0 and 1 so that you can detect marginally programmed bits. The cheapest commercial programmers don't have that feature at all. Higher-quality units do it partly in that they raise the supply voltage but not lower it. The "No Parts" PIC Programmer gives you full control over the supply voltage, making it easy to test any programmed part over the chip's full voltage range.

The author would like to acknowledge David Tait in England for his work on TOPIC, a PIC programming package of which the "No Parts" PIC Programmer is a direct descendant. Mr. Tait's work has been distributed on the Internet, and he has given his permission for this adaptation. The TOPIC software works with "No Parts" PIC Programmer hardware and vice versa. Because of that compatibility, the TOPIC package has been in-

SOURCES OF PARTS AND INFORMATION

Digi-Key Corporation

701 Brooks Avenue, South
Thief River Falls, MN 56701
1-800-DIGIKEY

<http://www.digikey.com>

Sells PIC microcontrollers and development systems.

Dontronics

P.O. Box 595
Tullamarine 3043
Australia

<http://www.dontronics.com>

Circuit boards, software tools, kits, and other supplies for PIC programming, many of them available nowhere else. Quick shipment all over the world.

Jameco Electronic Components

1355 Shoreway Road
Belmont, CA 94002
1-415-592-8097

<http://www.jameco.com>

PIC microcontrollers, other digital ICs, parts, and kits for the experimenter.

Microchip, Inc.

2355 W. Chandler Boulevard
Chandler, AZ 85224

<http://www.microchip.com>

Maker of PIC microcontrollers. Data books and free software distributed from web site and on CD-ROM.

Square 1 Electronics

P.O. Box 501
Kelseyville, CA 95451

squareone@zapcom.net

Publishes and sells two books, Easy PIC'n and PIC'n Up the Pace, which are excellent guides to PIC programming for the beginner.

cluded with the NOPPP software on the Gernsback Web site (www.gernsback.com). □

Plant Trees

10 Free Trees for Wildlife

Join The National Arbor Day Foundation and receive 10 Free Trees for Wildlife—Red Oak, Hawthorn, Bur Oak, Viburnum, Crabapple, Gray Dogwood, 2 Canadian Hemlock and 2 Redcedar, or other trees selected for your area.

Send your \$10 contribution to 10 Trees for Wildlife, The National Arbor Day Foundation, 100 Arbor Avenue, Nebraska City, NE 68410.



**The National
Arbor Day Foundation®**
www.arborday.org

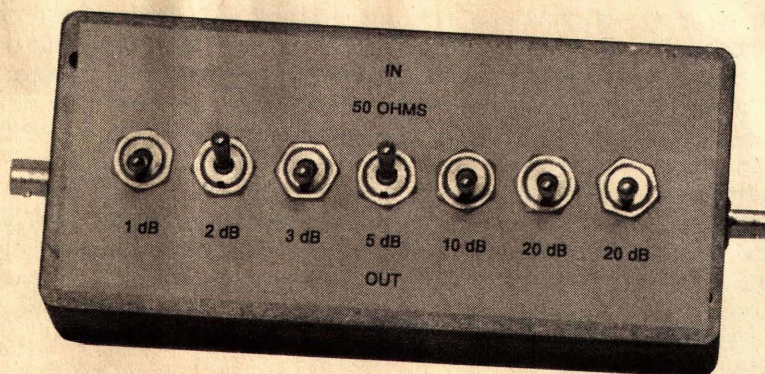
An attenuator is defined as "a device used to reduce the power (or voltage) level of a signal while introducing little or no distortion." They come in all shapes and sizes and can be arbitrarily placed in two general groups: active and passive, and the passive grouping can be further divided down into fixed and variable subgroups. As the name implies, the passive attenuators use only resistors to reduce the signal level, while the active devices use transistors or ICs to perform a resistance function. In this article, we are going to look into the various types of attenuators and attenuator circuits, show you how to use them, and show you how you can build your own.

Passive Fixed Attenuators. This type of attenuator is readily available as an off-the-shelf commercial product and is most often packaged as coaxial or plug-in modules. The coaxial models are usually built with SMA, N, or BNC connectors, as well as with special connectors such as the General Radio type "GR874," and have a usefully flat response from DC to 6 GHz (6000 MHz). Typically, plug-in units have 0.030-inch diameter pins arranged on a tenth-inch grid to allow them to plug into sockets or socket pins on a printed circuit board. Plug-in units are usually rated for a flat response from DC to 1500 MHz.

Inside, a passive fixed attenuator is made up of resistors connected in a "tee" or "pi" configuration as shown in Fig. 1. Also shown in that figure are the values of resistors needed for various levels of attenuation. Those values assume a 50-ohm line impedance, but values can be calculated for 75- or 93-ohm lines if needed.

Coaxial models could be built using ordinary 1/4- or 1/2-watt metal-film resistors, but then their high-frequency response would be limited to a few hundred megahertz at best. The 6-GHz (and higher) range is achieved using special coaxial resistors in which the thin resistive film is deposited on ceramic forms

ALL ABOUT ATTENUATORS



Here's some information on how attenuators work, how they're used, and a small sampling of circuits you can use the next time you need one.

that physically match the size of the outer conductive shell.

Both coaxial and modular (plug-in) attenuators are used to reduce power levels, set mixer input levels, balance phase-detector inputs, and so forth. Fixed models are generally less expensive and perhaps more stable than a variable unit would be in those applications.

One final note before we move on. Both the tee and pi networks work equally well. If building your own attenuator, the choice of which to use is largely determined by available resistor values.

Passive Variable Attenuators. This category is much larger than the "fixed" group, because it contains switched-tee and -pi units, continuously-variable attenuators, and voltage dividers.

It is easy to build a switched-tee attenuator. All you need are some 1% metal-film resistors, DPDT toggle switches, input and output connectors, and a suitable case. The circuit diagram in Fig. 2 shows a 50-ohm attenuator that can be set from zero to 61 dB in 1-dB steps. A tee design was used because it proved to be a

better fit to standard resistor values. The author's completed unit, which is shown at the beginning of this article, uses male BNC connectors and a cast aluminum case, such as those stocked by Mouser Electronics, Digi-Key Corporation and others (size isn't especially critical for this application). Some commercial attenuators use Teflon-body toggle switches to help extend the frequency range, but ordinary, off-the-shelf switches are usable to 50 MHz or higher if care is taken during construction.

This unit is used by the author for setting the output level of oscillators and function generators with inadequate internal attenuators, or none. It's also useful for checking the automatic gain control (AGC) range in a new receiver using a real off-the-air signal: just connect the attenuator between the receiver and antenna, tune in a signal, and increase the attenuation until the signal is lost.

Of course, any potentiometer, or "pot," is a continuously-variable attenuator. We use them in dimmer circuits for setting room illumination and controlling the sound level from all kinds of entertainment equipment, as well as in a myriad of other

applications. But sometimes a simple pot won't do. Figure 3 shows a constant-impedance continuously-variable attenuator used to set a function generator's output level. This particular circuit was used in the Hewlett-Packard model 3300A function generator, but it is typical of the breed. It provides a fairly constant 600-ohm output impedance that is independent of the voltage setting. The spec sheet says it has a 40-dB range; actually it's

about 45 dB. This is a useful circuit to keep in your bag of tricks, although finding the ganged pots might be a challenge.

Voltage Dividers. Since all attenuators are also voltage dividers, you might wonder why they are treated as a separate group. Though the author has not seen it stated this way, the difference in general is that attenuators are matched to the impedance of their source and

load, while voltage dividers aren't. Voltage dividers usually have a fairly high input impedance so they don't load the driving source. And they need a low enough output impedance so that their load does not appreciably change the output voltage.

Figure 4 shows a simple switched divider that the author built to increase the output voltage range of a function generator. It has a 10,000-ohm input resistance, which can be easily driven by the generator's 50- or 600-ohm output. A one-megohm or higher load, such as a voltmeter, changes the output voltage by no more than 1% at any switch setting. If built into a small cast aluminum case, this useful workbench accessory can be used wherever it is needed. The resistor values are easily scaled if you need either a higher or lower input resistance.

Precision voltage dividers are known as Kelvin-Varley dividers and often have large coin-silver switch contacts (for low resistance) as shown in Fig. 5. The circuit diagram for this unit (see Fig. 6.) shows a four-decade divider, though it could be extended to five, six, or even seven decades as needed. So, how does this divider work?

There are 11 equal-value resistors in the first or input decade. But two of those series resistors are always in parallel with the second decade. The second decade has a total series resistance equal to the paralleled pair in the first decade. Thus, the first decade looks like a simple 10-resistor divider.

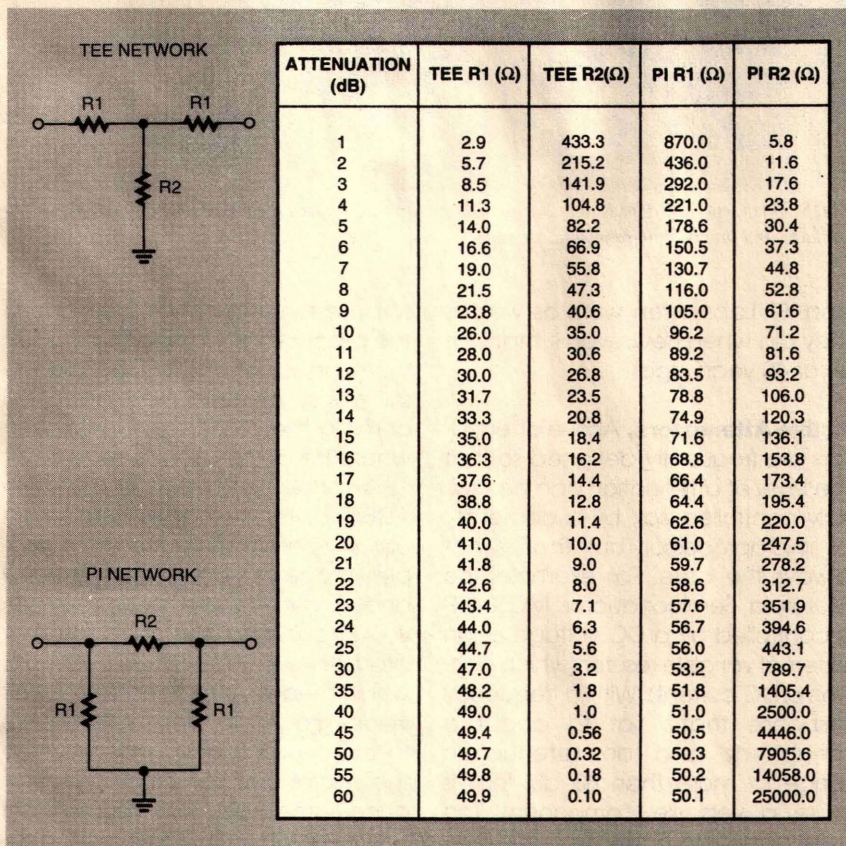


Fig. 1. To build your own passive attenuators, a simple tee or pi network can be used. The table of values in this figure assumes a line impedance of 50 ohms.

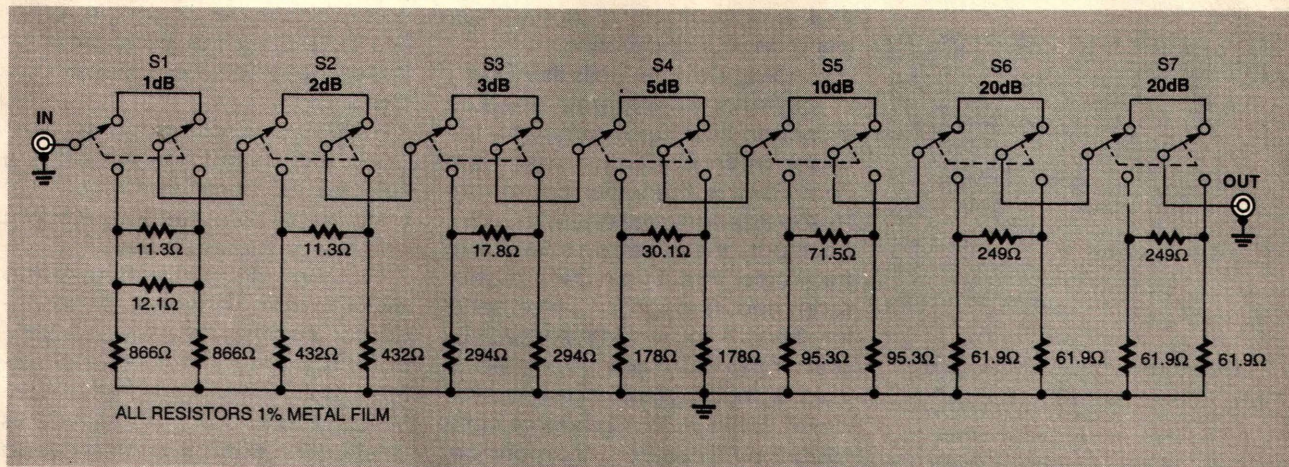


Fig. 2. Here's a 50-ohm attenuator that can be set from zero to 61 dB in 1-dB steps. A tee design was used because it proved to be a better fit to standard resistor values.

Continuing on, we see that this scheme is repeated: The third decade is always in parallel with two series resistors in the second decade, and so on. In short, we get a constant 5-to-1 resistance ratio between successive decades, which means that the resistance values can get rather small as we add decades. That becomes the practical limit on how many decades we can add. A seven-decade divider with a 100,000-ohm input resistance needs 0.64-ohm resistors in the last decade. The last decade is always a ten-step divider, or continuously variable pot, to enable a "unity" output. If that were not done, the maximum output would be 0.9999 (for four decades), which wouldn't quite do the job.

Kelvin-Varley dividers are usually built with highly accurate and stable resistors so as to have excellent linearity. Older models from companies such as General Radio, Electro Scientific Industries (ESI), John Fluke,

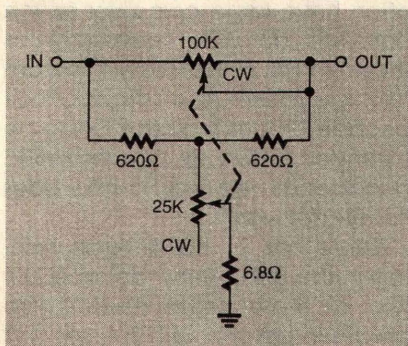


Fig. 3. Originally used in the HP-3000A function generator, this continuously variable attenuator provides a fairly constant 600-ohm output impedance that is independent of the voltage setting. Note that the potentiometers are ganged on a single shaft.

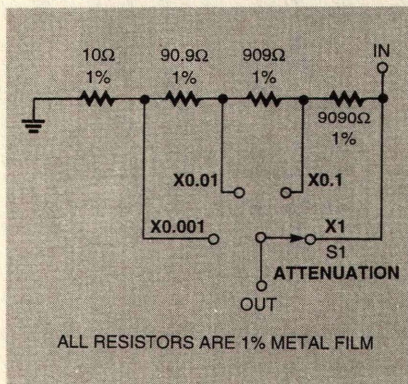


Fig. 4. This simple switched voltage divider was built by the author to increase the output voltage range of a function generator. It has a 10,000-ohm input resistance.

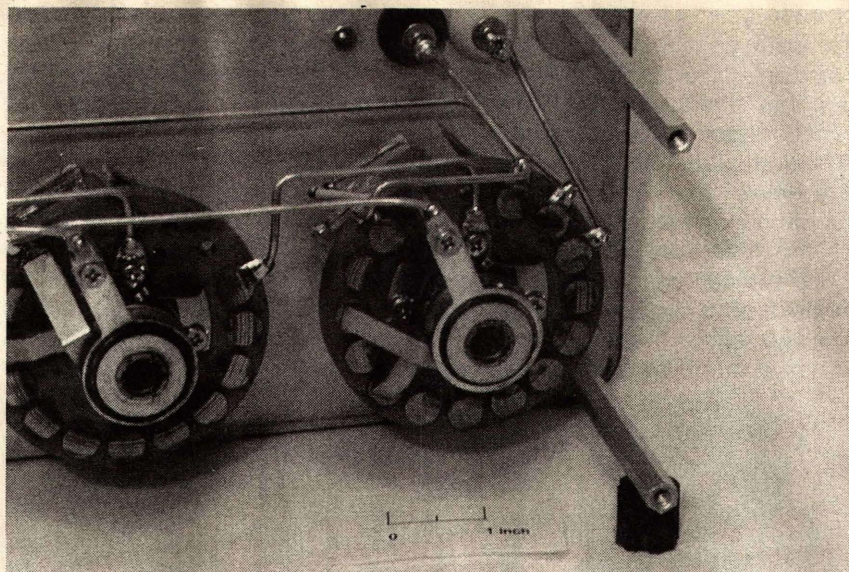


Fig. 5. This General Radio Kelvin-Varley voltage divider features low resistance coin-silver switch contacts and precision wire wound resistors.

and IET Labs often work as well as they did when new, even if that was 30 or 40 years ago!

Active Attenuators. Active attenuators are frequently designed so that the level of attenuation can be digitally controlled, say by a computer or microprocessor, but that is not always the case. For example, the Motorola Semiconductor MC3340P is controlled by a DC voltage or an external variable resistor (which controls a DC current). With a frequency response that's flat to about a megahertz and an attenuation range of more than 80 dB, that is quite a versatile component. The total harmonic distortion in the output signal rises to over 3% at attenuations of more than 40 dB. Whether that is acceptable or not will depend on your application.

Analog Devices calls its AD8402 a "digital potentiometer," because it uses an 8-bit input to control the wiper setting of a three-terminal "pot." That is, the wiper can be set to 256 different positions, with a digital input of 128 setting the pot to mid-scale. That 14-pin DIP IC is programmed through a 3-wire serial interface. A microcontroller such as one of the PIC models from Microchip Technology Inc. can read the on/off settings of a group of eight toggle switches or a thumbwheel switch and do the programming.

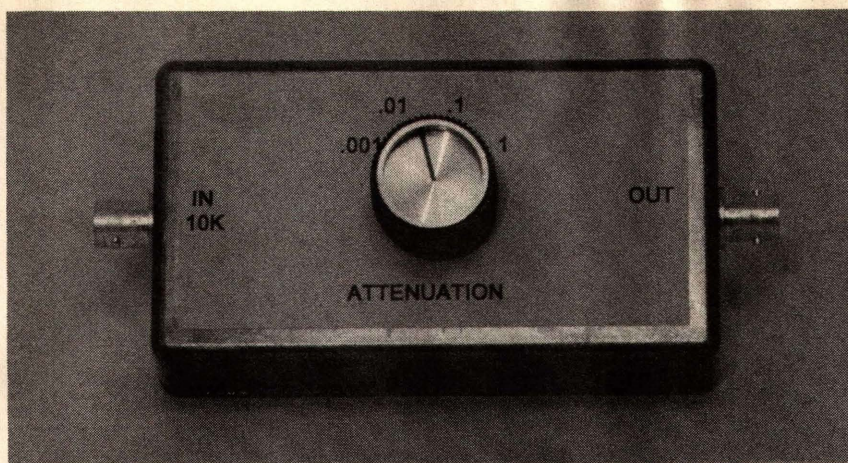
The author has used the AD8402

to build tunable active filters and in the process has learned that it's not quite an ideal resistor. The device still has some resistance, about 50 ohms in the 10,000 ohm unit, even when the digital input is all zeros.

Another limitation is that the AD8402 prefers that its associated circuit operate using the same supply voltage as it does; that is, ground and +5 volts. If there are op-amps in your circuit, they also need to operate between ground and +5 volts, which means you'll need a +2.5-volt virtual ground to bias the op-amps to the power supply midpoint. Also the microcontroller clock will introduce some noise into your analog signal—if you let it: The AD8402 contains latches that store the last programmed data; that means you can minimize the clock-noise problem by putting the microcontroller to sleep except when actually programming.

Don't be discouraged by that litany of problems; the AD8402 is a very useful component. You just need to be aware of its limitations and design around them.

Another alternative here is the LM1972 from National Semiconductor. It is billed as an audio attenuator, and the author has successfully used it in several industrial-control applications. Like the AD8402, its attenuation is programmed over a 3-wire serial interface. But unlike the AD8402, its attenuation changes



Here's the author's version of the circuit shown in Fig. 4.

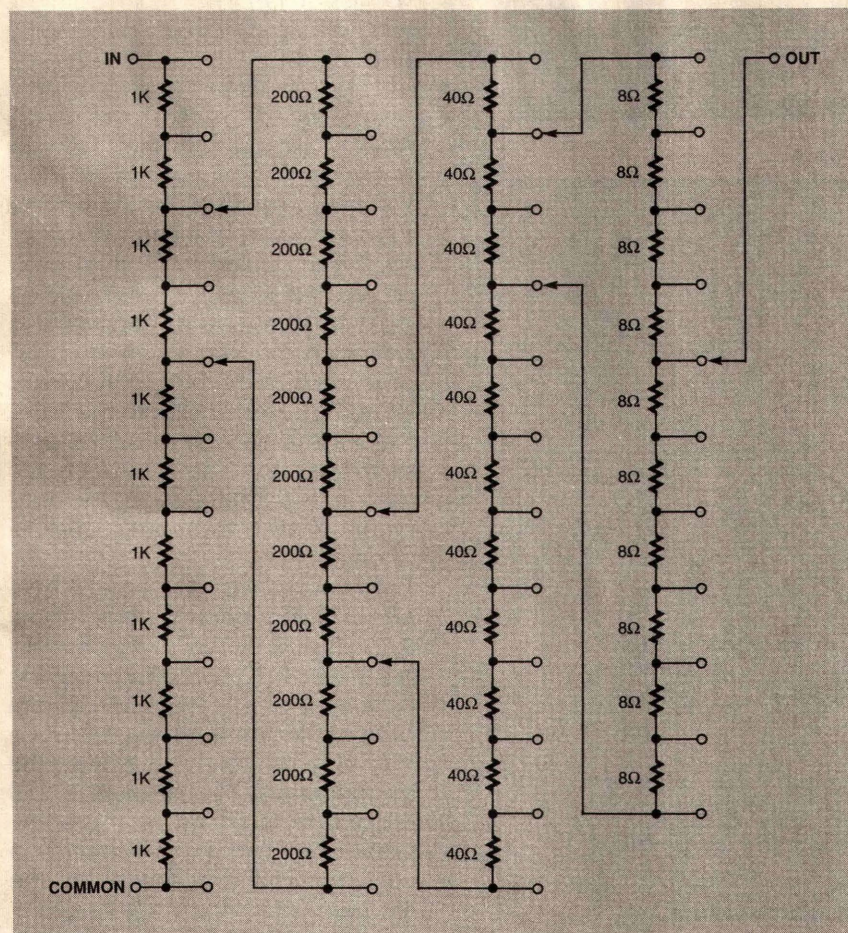
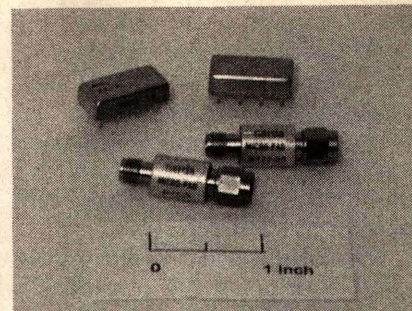


Fig. 6. The circuit diagram for the divider shown in Fig. 5 reveals that it is a four-decade device with a 5-to-1 resistance ratio between decades.

from zero to 78 dB in 0.5-dB steps up to 48 dB and then in 1-dB steps on up to the maximum. The frequency response is down 3dB at 100 kHz, and the total harmonic distortion (THD) plus noise is specified at 0.003% maximum. (National has targeted music-system applications with this device so they wanted it to be really quiet!)

Figure 7 is a circuit diagram of a variable attenuator you can build around an LM1972. Let's take a look at how it works.

The circuit makes use of a 1-of-12 keypad, which the author had on hand, to enter the desired attenuation. The line from each key connects to one of twelve input pins on a PIC16C73 microcontroller (as indi-



A pair of coaxial units with SMA connectors made by Narda Corporation (now Loral Microwave Narda), and a pair of plug-ins manufactured by Mini-Circuits.

RESOURCES

Analog Devices

PO Box 9106
Norwood, MA 02062-9106
Tel: 800-262-5643

Digi-Key Corporation

PO Box 677
Thief River Falls, MN 56701-0677
Tel: 800-344-4539

Loral Microwave Narda

435 Moreland Road
Hauppauge, NY 11788
Tel: 516-231-1700

Microchip Technology Inc.

2355 W. Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 602-786-7200

Mini-Circuits

PO Box 350166
Brooklyn, NY 11235-0003
Tel: 800-654-7949

Motorola Semiconductor Products

2100 E. Elliot
Tempe, AZ 85284
Tel: 602-244-6900

Mouser Electronics

958 N. Main Street
Mansfield, TX 76063-4827
Tel: 800-346-6873

National Semiconductor

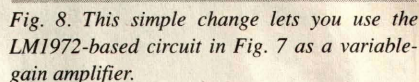
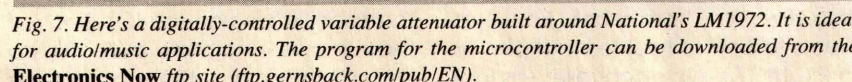
2900 Semiconductor Dr.
Santa Clara, CA 95052-8090
Tel: 800-272-9959

Scott Edwards Electronics

PO Box 160
Sierra Vista, AZ 85636-0160
Tel: 520-459-4802

cated by the dots on the lines from the specific pins on the IC). Each of these inputs is normally pulled up to +5 volts through a 4700-ohm resistor

The LM1972 has an input impedance of about 40,000 ohms, but its

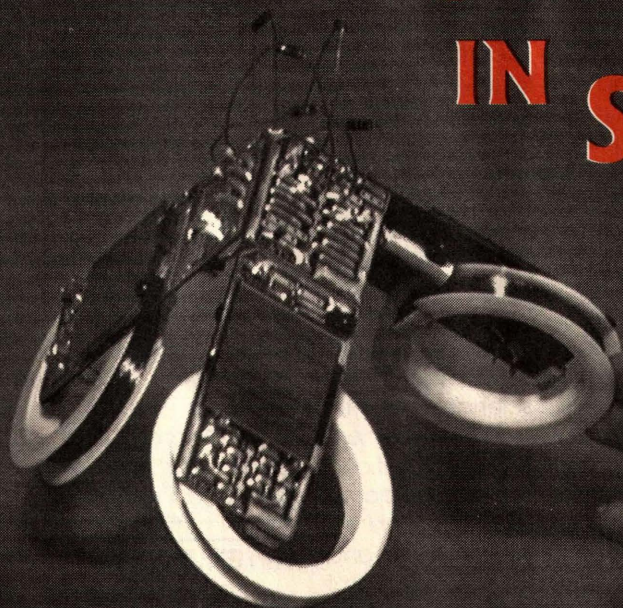


Lots of different display options are possible. The author used an LCD Serial Backpack from Scott Edwards Electronics to display the attenuation, though an RS-232 line driver had to be added to get it to work properly. If you decide to go that route, an "old-fashioned" LM1488 operating from the ± 15 -volt supplies is a better choice than a "+5-volt only" driver such as the MAX232A (Maxim Integrated Products). With the latter, the voltage-doubler switching transients are very difficult to decouple from the output signal, and that greatly limits the maximum usable attenuation.

The well commented source code (written in C) and the hex file needed to program the PIC are available on the **Electronics Now** ftp site (<ftp://ftp.gernsback.com/pub/EN/>) in file ATTEN.ZIP Application Note

(Continued on page 50)

"HOT WHEELS" IN SPACE



Does a new breed of tiny, super-simple microsatellites hold the key to the practical unmanned exploration of space?

DOUGLAS PAGE

A FLEET OF THESE TINY MICROSATELLITES would cost less, but could also accomplish missions that would not even be attempted with a single, more complex craft.

In recent years, the trend in unmanned spacecraft design has been toward smaller, faster, and cheaper. We no longer lift so many high-performance "Bentleys" and "Lamborghinis" into orbit; there are now a number of "Ford Escort"-class spacecraft circling the planet and doing good work.

The reason behind that is not just tight budgets. Too many of the costly, complex satellites launched recently have failed. The more complex the designs, the more prone they seem to be to failure. Balky antennas refuse to deploy. Flashes of space radiation burn-out delicate microprocessors. Links with earth-control stations are lost. That vulnerability has led some scientists to rethink traditional design philosophies that attempt to predict every anomaly and then pre-program the appropriate work-around.

"We can't anticipate everything that can go wrong, especially in

space and especially under current cost/risk constraints that bind space programs," says robot designer Mark Tilden, a research scientist in the Physics Division at Los Alamos National Laboratory (LANL), New Mexico. "We need engineering solutions that respond to unanticipated events in non-catastrophic ways."

In other words, everything has to be done differently. Tilden thinks even the Escort-class satellites are too complicated. Instead, he'd like to fill parking orbits with "Hot Wheels."

What Tilden is suggesting is a paradigm shift away from the highly-evolved space systems currently in operation. Rather than design spacecraft systems primarily to perform work and hope that they survive all anticipated problems, Tilden has turned design conception around. "We must instead design systems that automatically attempt to survive all circumstances and then try to extract useful work," he says.

Tilden colleague Kurt Moore says, "They represent the logical end of one evolutionary trend in space exploration toward clusters of small, cheap satellites that can achieve results even when some of them fail. They're so robust they could even be used to investigate the Van Allen radiation belts, which most earth-orbiting satellites avoid."

"Instead of designing systems that withstand their environment, we're engineering systems that rely on their environment. We're working on satellites that have no microprocessors or fixed algorithmic behaviors. Instead, these satellites are survivors—designed from the bottom up and domesticated by their sensors and control payloads into performing high-reliability tasks."

How Small Can You Go? If smaller is better for survival, how small can you make a satellite? At this past December's American Geophysical

Union meeting, the LANL team of Tilden, Moore, and Janette Frigo presented an idea for a constellation of microsatellites, each weighing no more than half an ounce with control systems based on the simplest animal neuron "twitches." You could carry these satellites in your pocket and launch them out of the shuttle cargo bay with a slingshot.

According to Tilden, a well-known innovator in the close-knit robotics community, the control systems of these insect-sized satellites are based on simple "nervous nets" (Nv), an instinct-like neural net in which a single electronic neuron is sufficient to produce a control pulse, or twitch, in a robotic creature lacking an advanced processor or computer command. Nv technology is based on the notion that a brain is of no use without a spinal cord. Indeed, most life on earth survives just fine without any brain at all.

Their "satbot," resembling a carefully folded sheet of construction paper, has three solar cells, a long-range antenna dish the size of a button, a short-range antenna probe no longer than a toothpick, a local sensor array, and three alignment coils. It weighs 10 grams and would fit in your hand.

That weight, say the researchers, not only reduces cost, but improves accuracy and response of the satellites for ranging and orientation purposes. The basic idea is to launch these satbots by the hundreds, huge stacks of them shearing themselves in orbit as a sweeping array of sensory "pixels," giving a whole new spectrum on the potentials of data measurement.

The whole idea is founded on the fact that space exploration is expensive and risky. However, Tilden says, satellites can be built cheap, rugged, self-programming, and radiation hardened. Those microsats may be the first step toward a whole range of long-term, low-cost space missions that would otherwise be prohibitively expensive.

Big Missions for Small Craft.

Beyond mapping the Van Allen Belt, other potential applications include measuring the solar wind and more precise earth imaging.

And that's just the beginning.

"We've done work on everything from lunar dust clearers, lunar miners and sorters, self-organizing heat-resistant tiles, broad-field pixels that can image asteroids or vast areas of space, to low earth orbit debris removers and single-mechanism interstellar explorers," says Tilden. "And there's not a computer in any of them. Most of them aren't even as complex as a transistor radio. Maybe it's a paradigm shifting without a clutch, but at least our devices work.

"The real goal eventually is to set up a whole organized branch of alternate robotic sciences powerful enough to think about colonization, and not just interstellar exploration," Tilden says. "The benefits will come from cheap access to space for people other than the big boys, and in innovative techniques that don't require NASA dependence. Find a way to sell a Sharper Image satellite for a thousand dollars with your choice of small payload, accessible and/or controllable through the Internet, and you'll see a revolution in amateur astronomy equal to the first ground-glass lens."

Tilden's nervous nets work like the neurons in animal nervous systems, which put out spiked pulses that hold useful information in the timing between the pulses. In computer terms, he says, the information needed to do work lives in the firing rate, not in a coded voltage level.

The Los Alamos satellite model shown in the beginning of this article is a microsatellite controller whose primary mission is to orient itself in earth's magnetic field. Using only a few transistors, those space 'bots seek the brightest available source—the sun—and orient themselves precisely toward it.

Acting like a delay line, the researchers say, electronic pulses from photodetectors travel first to one neuron and then the next. By adjusting the timing relationship between the pulses, the control system seeks the light and uses the reaction of the controller's magnetic field against earth's magnetic field for the torque needed to orient the satellite. With six neurons on three axes, the controller can move or examine different points in three-

dimensional space.

Moore says hundreds of microsatellites in orbit could relay simple streams of data to a communications mothership, which could integrate the data and pass it to ground stations. Measuring earth's magnetosphere is one potential mission. By locating a swarm of microsatellites on the sunward side of the magnetopause, scientists can take real-time measurements of the energy transferred to earth's magnetic field by the turbulent solar wind. "We've never been able to do real-time monitoring of the position of the magnetopause as the solar wind pushes it around," says Moore. "With hundreds of these microsatellites we should be able to do that." Ω

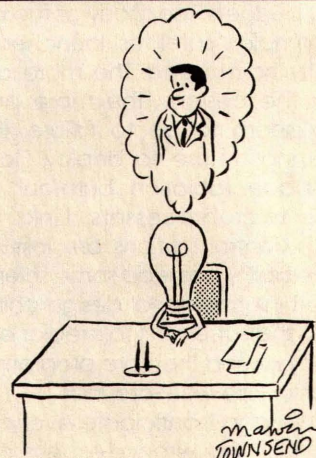
ATTENUATORS

(continued from page 48)

AN529, available from Microchip Technology Inc., describes a 4 3 4 sampled keypad and LED driver that could also be used to set and display the attenuation.

A simple change, shown in Figure 8, lets you use the LM1972 as a variable-gain amplifier. Since the op-amp shown in the figure has a low output impedance, a separate output buffer is usually not needed.

The author is available to answer (or try to answer) questions on any of the devices in this article. I'm usually difficult to reach by phone so please write, fax, or e-mail Ron Tipton, 5260 Cochise Trail, Las Cruces, NM 88012; Fax: 505-382-8810; e-mail: RTipton@zianet.com. Ω



SEE MUSICAL PITCHES WITH THE DIS·PLAYER



If you have a musical instrument that doesn't have keys, valves, or some other way to create a pitch that is in tune with the standard diatonic (chromatic) scale of Western music, you probably know the frustration connected with trying to play even the simplest tune. Learning how to play an instrument such as a violin, trombone, something as esoteric as a Theremin, or even something as simple as a slide whistle can frustrate even the most dedicated aspiring musician.

The DisPlayer project presented here is just the item needed in those situations. A visual indication of which note is being played helps you learn how to hit the correct pitch without hunting for it. The display is designed to look like a piano or organ keyboard. With a three-position switch, the three-octave display can be extended to five octaves. You'll be amazed at how quickly and easily you'll pick out recognizable tunes with the DisPlayer's help. As a bonus, the DisPlayer includes a VU meter that acts as a volume display. That circuit is completely separate from the rest of the DisPlayer. It comes in very handy if you're working with an electronic instrument or amplifying an acoustic one. In general, the DisPlayer's usefulness is limited only by your imagination.

How It Works. The schematic diagram for the DisPlayer is shown in Fig. 1. Although it looks complex at first glance, it is really quite simple and straightforward. The circuit can be

divided into several sections.

The heart of the circuit is the tone- or pitch-display section, and it is based on the popular LM3914 display driver. That device drives ten LEDs in a linear display, with programmable endpoints and the choice of either a "dot" (one LED at a time) or a "bar" (from one to several LEDs in order) display. Furthermore, it is possible to "chain" multiple devices together to create displays of theoretically unlimited size, though the application notes from National Semiconductor usually recommend a limit of ten devices.

Display drivers IC7-IC10 are wired in a chained "minimum-parts" configuration with a dot display. Showing only one LED at a time makes it easy to interpret the display. It also places less demands on the power supply. The LED current is set to about 20 milliamperes, making for a bright, easy-to-read display.

The display itself is made from LED10-LED50. Arranging them in a keyboard pattern makes notes eas-

Frustrated by trying to play "in key" with your trombone or fretless base? Want to know what pitch someone is singing? This handy device is the next best thing to having a friend with "perfect pitch"!

ier to recognize by anyone with piano or keyboard experience. To further simplify reading the display, red LEDs were used to represent the white keys and green LEDs for the black keys of a piano. The lowest note is an "A," and the highest note is a "C" that is a bit over three octaves higher. That last LED (LED50) will remain lit when the input signal goes higher. If you prefer the display to go blank when out of range, LED50 can be left out. If you do use it, it would be a good idea to use yet another color such as orange or yellow for that device. That will remind you that the DisPlayer is at or beyond its upper limit, and that the display is not necessarily correct.

Note that there are resistors placed across the first and ninth LEDs of each LM3914. Those resistors are there to reduce or eliminate the dim glow that those LEDs would emit because of the small currents that pass through them. Those currents are by-products of the way that the LM391x family of devices connect to one another when in "dot" mode. If you aren't bothered with that dim

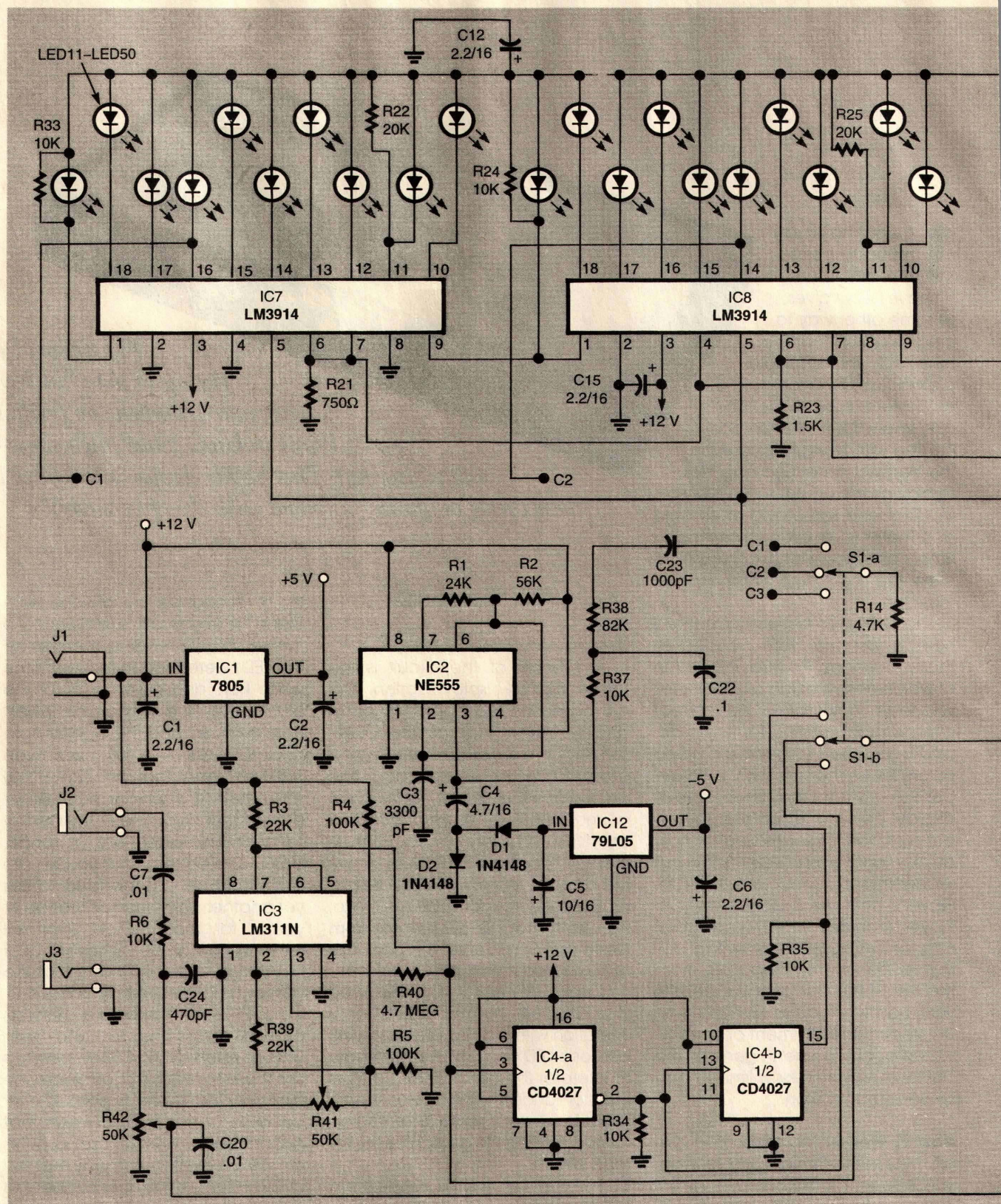
glow, R22, R24, R25, R27, R28, R30, R31, and R33 can be omitted.

The resistors between pins 6 and 7 of each display driver and ground set the LED current. Note that they

are not the same value; that is because the reference voltage of each successive driver is 1.25 volts higher than the previous one in the chain. The inputs of the LM3914s are

tied together, resulting in a continuous linear display with a full-scale voltage of about 5 volts.

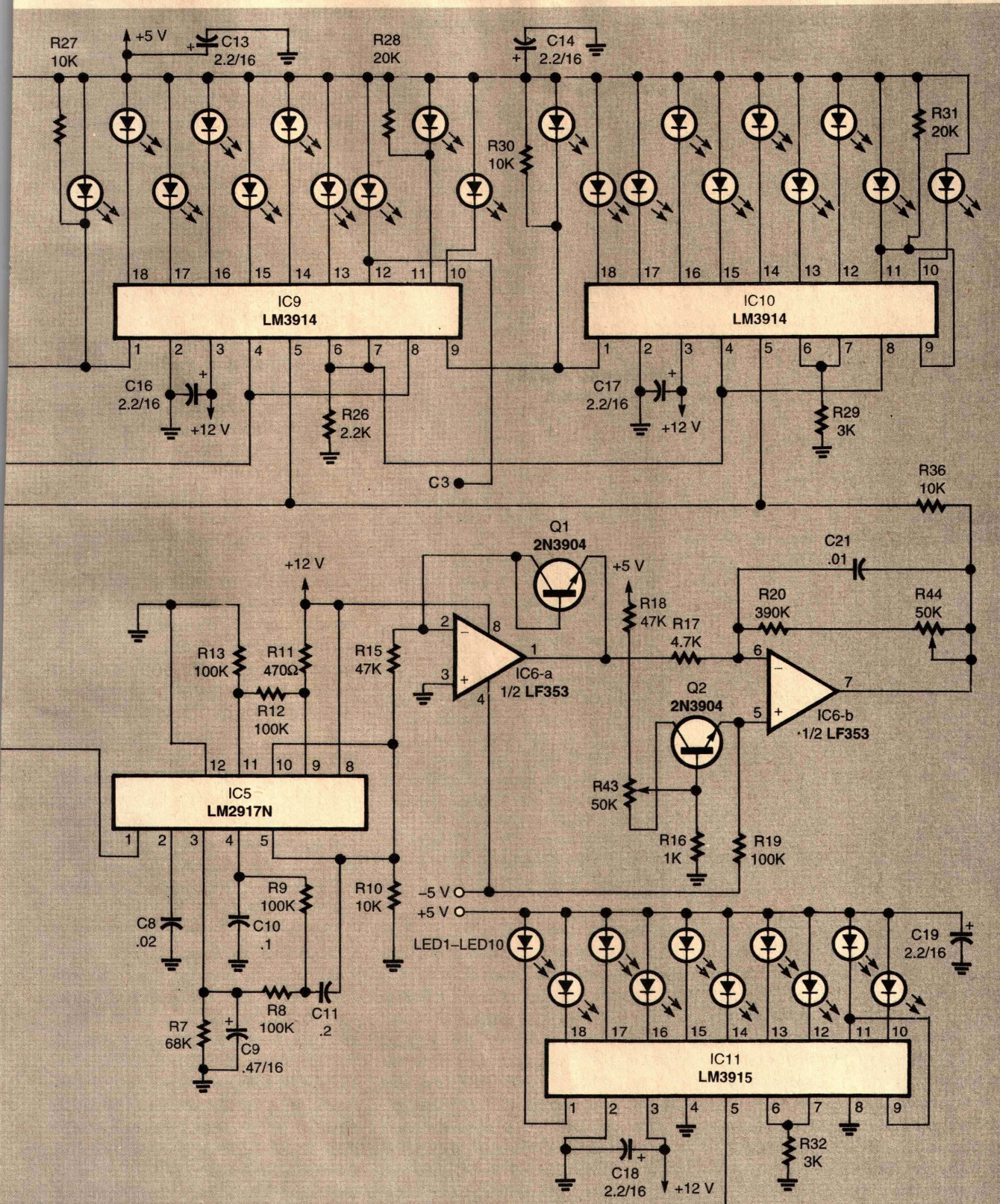
One quirk of the LM391x family of display drivers is that they need



to be well bypassed on both the LED supply and the main supply lines. That's why there are all of those 2.2- μ F tantalum capacitors along the LED supply rail and on pin

3 of each LM3914. If you try omitting some or all of them, you might be lucky. However, there is a good chance that you will end up with bizarre displays due to oscillations.

"Scale" Conversion. At this point, we should note that the pitches that we are displaying represent a logarithmic scale: each time we double the frequency (go up an



PARTS LIST FOR THE DISPLAYER

SEMICONDUCTORS

IC1—LM7805 5-volt positive regulator, integrated circuit
 IC2—NE555 timer, integrated circuit
 IC3—LM311N dual comparator, integrated circuit
 IC4—CD4027 dual J-K flip-flop, integrated circuit
 IC5—LM2917N frequency-to-voltage converter, integrated circuit
 IC6—LF353 dual op-amp, FET input, integrated circuit
 IC7—IC10—LM3914 LED linear-display driver, integrated circuit
 IC11—LM3915 LED logarithmic-display driver, integrated circuit
 IC12—79L05 5-volt negative regulator
 Q1, Q2—2N3904 NPN transistors (from same production run—see text)
 LED1-LED3—Light-emitting diode, green (T-1 package)
 LED4-LED6—Light-emitting diode, yellow (T-1 package)
 LED7-LED10—Light-emitting diode, red (T-1 package)
 LED11-LED50—Light-emitting diode, T-1 $\frac{3}{4}$ package (see text)
 D1, D2—1N4148, silicon diode

RESISTORS

(All resistors are $\frac{1}{4}$ -watt, 5% metal-film units unless otherwise noted.)

R1—24,000-ohm
 R2—56,000-ohm
 R3, R39—22,000-ohm
 R4, R5, R8, R9, R12, R13, R19—100,000-ohm
 R14, R17—4700-ohm
 R6, R10, R24, R27, R30, R33—R37—10,000-ohm
 R7—68,000-ohm
 R11—470-ohm
 R15, R18—47,000-ohm
 R16—1000-ohm
 R20—390,000-ohm
 R21—750-ohm
 R22, R25, R28, R31—20,000-ohm
 R23—1500-ohm

R26—2200-ohm
 R29, R32—3000-ohm
 R38—82,000-ohm
 R40—4.7-megohm
 R41—R44—50,000-ohm potentiometer (see text)

CAPACITORS

C1, C2, C6, C12-C19—2.2- μ F, 16-WVDC, electrolytic
 C3—3300-pF, ceramic-disc
 C4—4.7 μ F, 16-WVDC, electrolytic
 C5—10 μ F, 16-WVDC, electrolytic
 C7, C20, C21—0.01- μ F, ceramic-disc
 C8—0.02- μ F, Mylar, 5%
 C9—0.47- μ F, 16-WVDC, electrolytic
 C10, C22—0.1- μ F, ceramic-disc
 C11—0.2- μ F, ceramic-disc
 C23—1000-pF, ceramic-disc
 C24—470-pF ceramic-disc

ADDITIONAL PARTS AND MATERIALS

J1—Hollow pin jack, 2.1 mm.
 J2, J3— $\frac{1}{4}$ mono phone jack
 S1—2-pole, 3-position or 3-pole, 4-position rotary switch (see text)
 PC board, 12-volt DC, 200 mA power supply, wire, hardware, case, etc.

Note: The following items are available from: SK Electronics, Kit Division, 902 Front St., Nelson, BC V1L 4R2, Canada; Tel: 250-352-7292; Fax: 250-354-4070; e-mail: skecomm@netidea.com: Complete kit of all parts, PC board, power supply, and front panel, \$89.00 (\$129.00 Canadian); Partial kit of PC board and parts, \$79.00 (\$119.00 Canadian); PC board only, \$15.00 (\$22.00 Canadian). Please add \$3.00 (\$5.00 Canadian) for shipping and handling on kits; \$2.00 (\$3.00 Canadian) for PC board shipping. Canadian residents must add 7% GST. BC residents must add 7% PST. Visa and MasterCard accepted. No COD orders will be accepted.

current through one of the LEDs that represent "C" on the keyboard. The selected LED glows dimly, marking the location of "middle C".

The selected frequency is converted to a voltage by IC5. If you are using an electronic instrument that already generates a voltage that represents the frequency of the sound, the input circuit up to this point would not be needed. However, some instruments might not be as linear as they should be. Keeping the DisPlayer a universal design that can be used with any sound source makes the unit much more versatile as well as precise. An added advantage of IC5 is that it has a built-in op amp that can be used for filtering any ripple—a necessity to properly display the lower frequencies. Without ripple filtering, more than one LED would be lit in the lower ranges. The 14-pin version of the chip lets us access the op-amp's inputs—a necessity for filtering out the ripple.

Resistors R12 and R13 set IC5's reference at $\frac{1}{2}$ of the supply voltage. R11 is a load for the built-in Zener diode. Capacitor C8 and resistor R7 program the chip's frequency-to-voltage range. They have been chosen to give a full-scale voltage of about 6.5 volts when the input frequency is at 550 Hz. The above-mentioned ripple filter is formed by R8, R9, C10, and C11. Finally, R10 forms the load for IC5's open-emitter output.

The values shown in the schematic are for a minimum frequency of 55 Hz, which is the A that is two octaves below middle C. With S1 in the third position, the highest frequency is 2093 Hz. The bottom end is a pretty low bass note.

So now that we finally have a voltage that is a linear analog of the incoming frequency, how do we take the logarithm of that voltage for proper display on our visual keyboard? The key to the answer is the fact that the voltage across a transistor with its base and collector tied together is proportional to the logarithm of the current passing through it. In practice, that means that the collector/base-to-emitter voltage increases by about 17 millivolts for every doubling of current.

The first section of IC6 makes use

octave), the voltage to the display section should increase by a fixed amount—about 1.5 volts in practice. So how does a logarithmic frequency input get converted into a linear voltage for display on our "visual keyboard?" For that answer, we have to go to the opposite end of the circuit.

The incoming frequency signal is applied to IC3, an LM311 comparator that converts it into a square-wave with the proper levels to drive the next part of the circuit. Resistor R41 sets the amount of signal that is

applied to the comparator. That helps make sure that there is enough signal for reliable operation across the usable range of the DisPlayer while minimizing the display of noise. Resistors R4 and R5 set the toggle point of the comparator at $\frac{1}{2}$ of the supply voltage, and R3 forms the load for IC3's open-collector output.

The signal then passes through two frequency-divider stages, built around IC4. One of the outputs is selected by S1-b, letting us choose one of three octave ranges. The other part of S1 (S1-a) sinks a low

of that fact. To briefly review op-amp theory, an ideal op-amp will have zero volts across its differential inputs (infinite voltage gain) and an infinite input resistance (zero input-bias current). Fortunately, the JFET op-amp that we're using approaches that ideal very closely. In the inverting-amplifier configuration, the current through Q1, the "feedback element" with its base and collector tied together, equals the current in "input element" R15. Furthermore, the current in R15 will be directly proportional to the applied voltage. The result is an output voltage that is proportional to the logarithm of the input voltage.

Using a JFET-input op-amp is important when doing linear-to-log conversions. Even the smallest input bias currents (like the 50-nanoamp rating of an LM358) are enough to mess up our linearity. The LF353 device typically has an input current that is three orders of magnitude less—50 picoamps—and is far better suited to our needs.

The logarithmic output voltage is inverted, so the second section of IC6 inverts it again. That section also sets the gain with R44 and the zero offset with R43. Making both stages inverters eliminates complications that result from trying to make a non-inverting log amp.

There is another very important job assigned to IC6-b: temperature compensation. Another interesting property of the transistor with its base and collector tied together is that, at a given current, the voltage across it is a linear representation of temperature. That feature is useful for any number of temperature-measuring applications, but a real drawback for log amps.

Transistor Q2 is included in the biasing network for IC6-b. A temperature-induced voltage change in Q1 will (presumably) cause the same degree of change in Q2. The circuit is wired in such a way that the effects of those voltage changes cancel each other out. That is why both Q1 and Q2 should be chosen from the same production run. While a dual transistor (two transistors on the same die) could also be used, cost and availability make any improvements not worth the effort. If you're really concerned about sta-

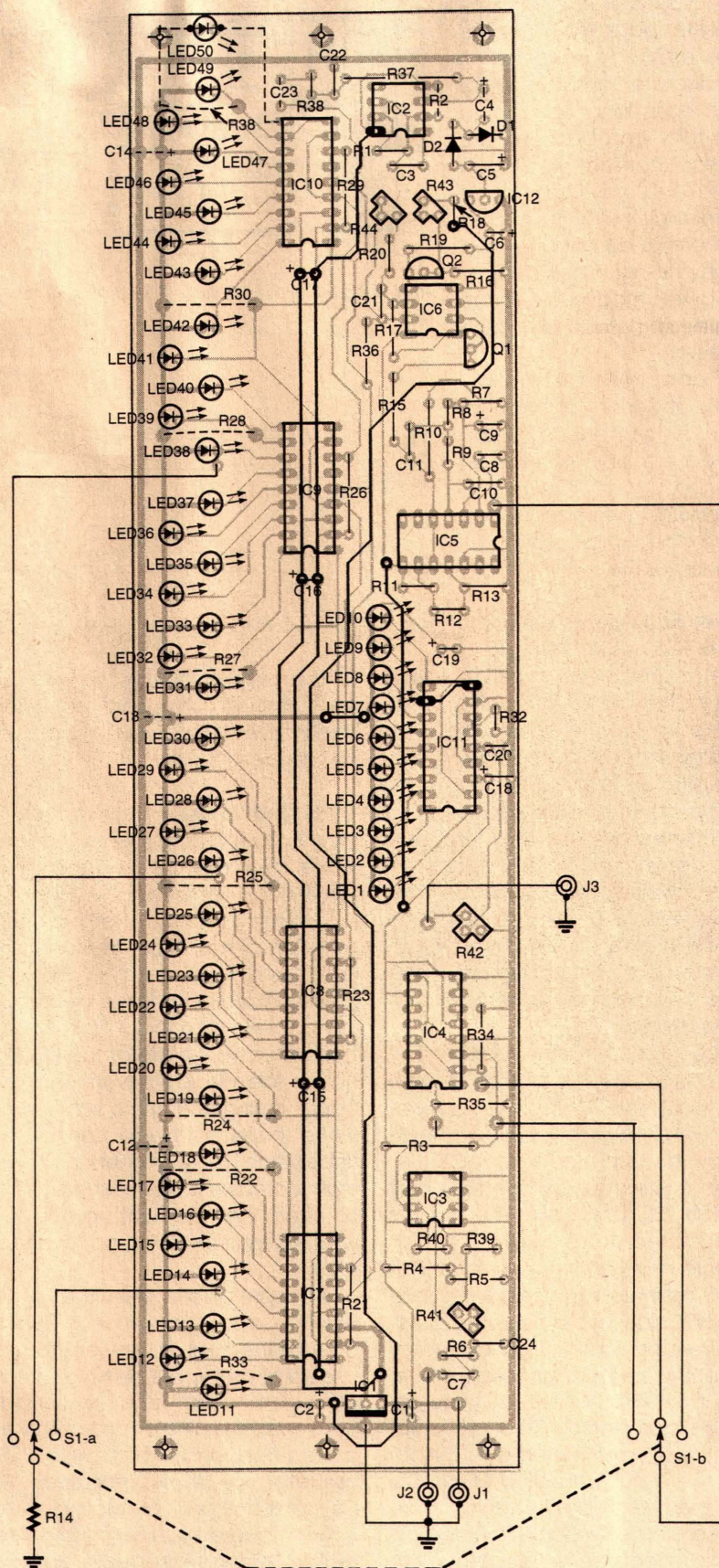


Fig. 2. Use this parts-placement diagram when building the DisPlayer with the PC board foil patterns. Some components are mounted on the underside of the board so that the LED "keyboard" looks neat and professional.

bility, you can use a dual-transistor package. An alternate method would be to use discrete transistors, leave their leads long enough so that they can be bent into physical contact with each other, and physically bond them together with a dab of thermal compound and a tiny elastic band. That will give virtually the same degree of stability as a dual transistor.

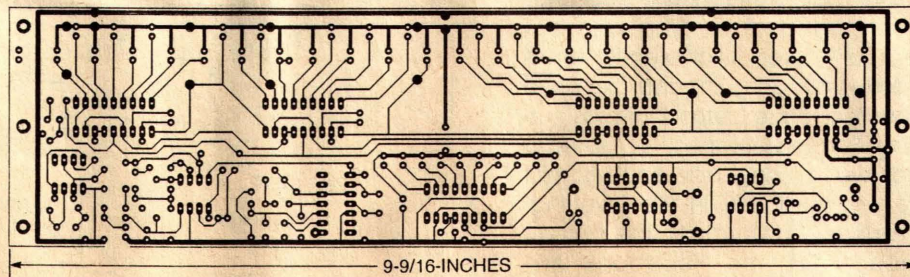
Capacitor C21 eliminates any residual ripple or other high-frequency noise picked up along the way. The output from IC6-b passes through summing resistor R36 to the inputs of the display driver ICs.

Power Supply. As mentioned earlier, IC5 has its own built-in

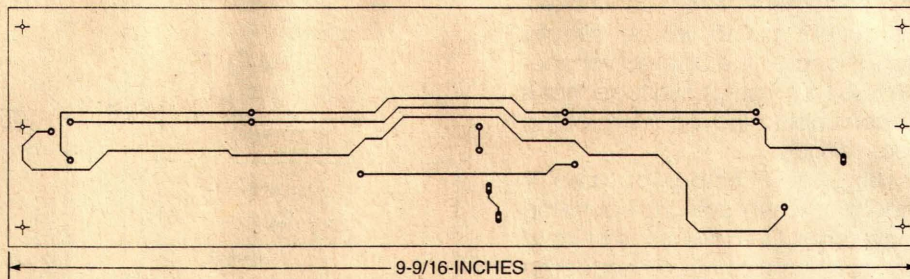
Zener regulator, so any supply voltage in the range of 10–14 volts will be fine. Similarly, the other IC's power requirements are quite forgiving. The exception is IC6. While it doesn't really care about its supply voltage, the biasing network, including temperature compensator Q2, needs to have a well-regulated voltage. That is one reason for the use of IC1. As with the display drivers, using a 2.2- μ F tantalum capacitor at its output prevents any possible oscillations that could ruin your day.

The regulator also supplies the LED current for the display drivers. Running the LED supply on a lower voltage greatly reduces the heating on the display driver ICs.

A negative-supply inverter is built around IC2, an NE555. The timer is being used in a variant of an astable-multivibrator circuit. It has been optimized to create as close to a 50%-duty-cycle output as possible. Resistors R1, R2, and capacitor C3 set the frequency of oscillation to about 3.8 kHz. The resulting square-wave is clamped by C4 and D1, rectified by D2, and filtered by C5. Note that the circuit consisting of C4, C5, and the two diodes is nothing more than a classic "voltage-doubler" circuit. In effect, we're "doubling" the peak value of the squarewave relative to its average level. The result is a negative voltage that is about equal



Here is the foil pattern for the solder side of the DisPlayer. It is shown here at 50%.



Here is the foil pattern for the component side of the DisPlayer. It is shown at 50%.

to the original positive supply voltage, although it has poor regulation. That is taken care of by IC12, a 5-volt negative regulator.

Odds and Ends. Since we have a clean constant-frequency square-wave available, let's add another refinement: fine tuning. As the display section stands so far, we could be off by almost a quarter-tone with any given LED being lit. We can greatly improve that by superimposing a low-level (about 80 millivolts) triangle wave on top of the DC signal to the display drivers. That will cause a single lamp to light only if we're close to being "on pitch," since each LED represents a 125-millivolt increase. If we're even a little off pitch, the next light up or down will start lighting, giving an "overlap" effect.

It might seem odd that we'd want to add ripple to our display after all the trouble we went to getting rid of any ripple being generated by the frequency-to-voltage converter. The difference is that with a fixed-frequency source like a 555 oscillator, the ripple amplitude will be constant and predictable. The 3.8-kHz squarewave from IC2 is integrated into a reasonable approximation of a triangle wave by R37 and C22. It is injected into the inputs of the display drivers through the

voltage divider formed by R38 and R36. Capacitor C23 provides DC isolation so that the fine-tuning circuit does not affect the DC level coming out of IC6-b.

Volume Display. After all of the design work that has gone into the DisPlayer, the volume-display section is almost trivial by comparison. An LM3915 and ten LEDs make up the circuit, automatically giving us a logarithmic scaling. If you want a "bar" display, tie pin 9 of IC11 to pin 3 instead of to pin 11 as shown. You don't even need to rectify and filter the incoming audio source; the LM3915 works fine straight from a line-level input with a maximum peak voltage of 1.25 volts or greater. If you use the dot mode as shown in Fig 1, the display will be a "quasi-bar" that shows the peak values and also suggests the average value.

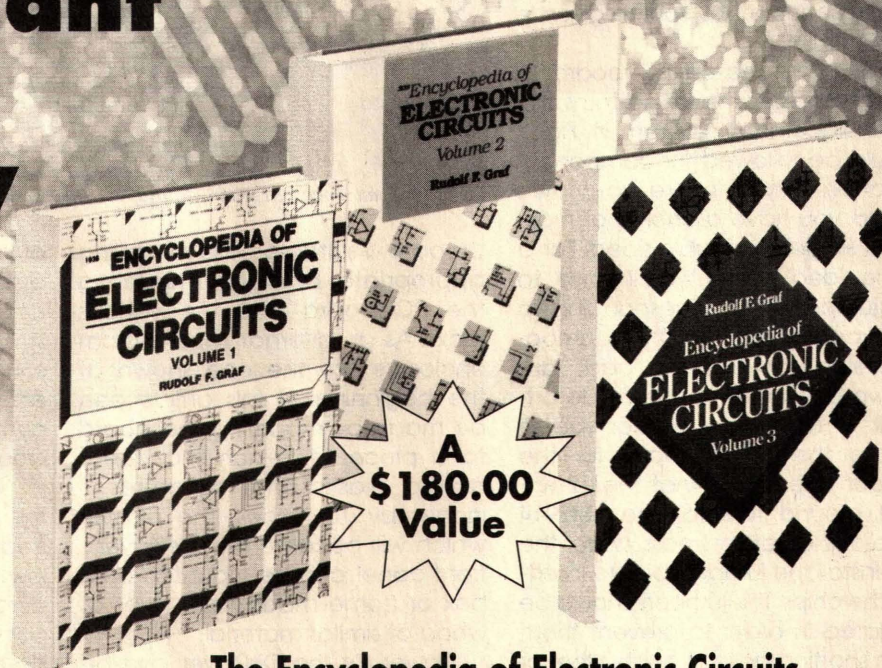
Incidentally, if you're wondering why we didn't just use LM3915s in the tone-display section, it's because the logarithmic steps are fixed at 3 dB (about 41% increase per step) rather than the approximately 4% increase per step needed to display half-tones.

Building the DisPlayer. There is, of course, no reason why you can't build the DisPlayer on a piece of perfboard. However, using a printed-

Take This Giant Circuit Library For Only \$495

when you join the
**Electronics
Engineers'
Book Club®**

"...includes schematics for the latest electronics
circuits from industry leaders..."
—Popular Electronics



The Encyclopedia of Electronic Circuits
Volumes 1-3 by Rudolf F. Graf
2,344 total pages • 3,490 total illustrations

**Hundreds of circuit ideas alphabetically
arranged—from Alarm circuits to Zero
crossing detector circuits!**

Turn to this comprehensive circuit library for hundreds of project ideas...valuable troubleshooting and repair tips...and concise pinout diagrams and schematics. Each volume contains more than 700 electronic and integrated circuits and covers 100+ circuit categories.

As a member of the
Electronics Engineers' Book Club...

you'll enjoy receiving Club bulletins every 3-4 weeks containing exciting offers on the latest books in the field at savings of up to 50% off the regular publishers' prices. If you want the Main Selection, do nothing and it will be shipped automatically. If you want another book, or no book at all, simply return the reply form to us by the date specified. You'll have at least 10 days to decide. If you ever receive a book you don't want due to late delivery of the bulletin, you can return it at our expense. Your only obligation is to purchase 2 more books during the next 12 months, after which you may cancel your membership at any time. And you'll be eligible for FREE BOOKS through our Bonus Book Program.

Publisher's price shown. © 1998 EEBC

If coupon is missing, write to:

Electronics Engineers' Book Club®

A Division of The **McGraw-Hill** Companies
P.O. Box 549, Blacklick, OH 43004-0549

Phone: 1-614-759-3666

(8:30 am to 5:00 pm EST Monday-Friday)

Fax: 1-614-759-3749

(24 hours a day, 7 days a week)

Internet: www.bookclubs.mcgraw-hill.com

ELECTRONICS ENGINEERS' BOOK CLUB®

A Division of The **McGraw-Hill** Companies, P.O. Box 549, Blacklick, OH 43004-9918

☐ **YES!** Please send me The Encyclopedia of Electronic Circuits-Vols. 1-3 (5857863), billing me just \$4.95, plus shipping/handling & tax. Enroll me as a member of the **Electronics Engineers' Book Club** according to the terms outlined in this ad. If not satisfied, I may return the books without obligation and have my membership cancelled.

Name

Signature

(Required on all orders)

Address/Apt.#

City State

Zip Phone

Valid for new members only, subject to acceptance by EEBC. Canada must remit in U.S. funds drawn on U.S. banks. Applicants outside the U.S. and Canada will receive special ordering instructions. A shipping/handling charge & sales tax will be added to all orders.

RPIF998C

circuit board results in a neater overall appearance of the unit. You can etch your own board using the foil patterns included here, (**note:** due to their size, the boards are reproduced here at 50%) or one may be purchased from the source given in the Parts List.

For a purchased PC board or one made from the foil patterns, the parts-placement diagram in Fig. 2 should be followed for component location. If you make your own board, you have a choice of making a single- or double-sided. For a single-sided board, you'll have to run jumper wires corresponding to the traces shown on the "component-side" artwork. All pads are shown on the component-side artwork to make it easier for you to locate the proper pads for the jumper wires. Note that the 12-volt and ground rails for the LM3914 tone-display drivers pass *under* the ICs; install the jumpers before inserting the chips. The jumpers should be insulated in order to prevent them from shorting against each other or any component leads. The foil patterns provide extra pads on either side of the bypass capacitors for the jumpers.

If you decide to use a double-sided board, you don't have to worry about installing any jumpers—but you'll have to run feed-through wires that will connect the traces on both sides of the board. You don't have to drill out the pads on either side of the bypass capacitors; simply solder the capacitor leads on both sides of the board.

There is no particular order for installing the components. However, since IC4 is sensitive to electrostatic discharge, it's a good idea to install that component last. As usual, be careful about proper orientation of polarized components, such as ICs, transistors, diodes, and electrolytic capacitors. The shorter lead on LEDs is generally the cathode, but for good measure check for the little flat spot on the base of the LED; that flat spot marks the cathode and goes towards the driver ICs. If you decide to install LED50, solder it into the holes indicated and run short jumper wires to the 5-volt rail and to pin 10 of IC10 as shown in Fig. 2.

Once the board is completed,

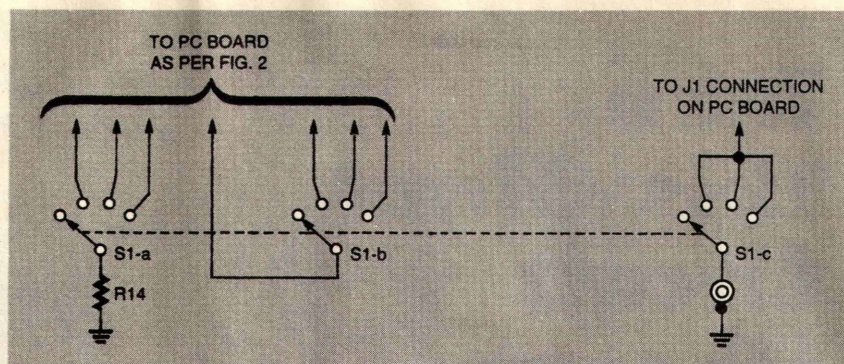


Fig. 3. You can replace S1 with a 4-position unit and use the additional pole as an on-off switch.

prepare a suitable case by drilling appropriate holes for mounting the PC board and the various jacks. As an alternative, a custom enclosure like the one shown at the beginning of this article can be made by mounting the board to a piece of 1/4-inch-thick clear acrylic plastic that measures 3 inches by 10 inches. The plastic, which will become the DisPlayer's front panel, can be mounted on a box or frame made from strips of wood or similar material.

Power for the DisPlayer can be any suitable source of 12-volt DC power with a current capacity of at least 200 mA; a 500-mA unit with an internal 12-volt regulator to reduce ripple is preferred. If you want to switch the power supply, you can use a toggle switch between J1 and the PC board. An alternative method is shown in Fig. 3. In that arrangement, S1 is changed to a 3-pole, 4-position switch. The third pole, S1-c, is used as a power switch, applying power to the DisPlayer when any of the octaves are selected.

For now, don't connect S1-a or S1-b. Preliminary testing can be done by making a temporary connection between pin 1 of IC5 and pin 7 of IC3.

After checking your work for correct values, component orientation, and good solder joints, do some continuity checks with an ohmmeter. Make sure that you don't have direct shorts between supply and ground. When you're satisfied that everything looks okay, it's time to test the DisPlayer.

Testing and Adjustment. Set all of the pots to the center of their rotation. Apply a waveform of a known frequency to J2. One good source

of a constant-frequency, constant-amplitude signal is a synthesizer or other electronic keyboard instrument; select the "cleanest" sound that is available. Turn off any effects, harmonics or after-touch dynamics. A clean "flute" sound would be perfect.

You might not see any lights at this point. However, if you vary the frequency generator through its lower range or play your instrument across its range, you should at some point see the pitch display come to life. If nothing lights up, try increasing the amplitude of the input signal. If the DisPlayer still doesn't respond, review the circuit-description section and trace the signal through the circuit (preferably with an oscilloscope) to see where it is disappearing. Check the output of IC5 (pin 5 or pin 10) with a DC voltmeter; you should get a varying voltage between zero and about 6.5 volts as you sweep through the frequency range.

Assuming that all is well so far, adjust R41 just beyond the point where the display stabilizes when you play a note or apply the signal generator. If you turn it too high, you might get funny displays due to harmonics or background noise.

Feed a 55-Hz signal into the DisPlayer. On a keyboard, that note would be the third A below middle C. Adjust R43 until LED11 comes on. Set the generator to 440 Hz (A above middle C). Adjust R44 until the high A (LED 47) lights. Repeat those two adjustments until they are stable.

Finish wiring S1 for the final test. Shielded wire for S1-b is suggested; that switch pole will be carrying high-level squarewaves that could

(Continued on page 68)



Vehicle navigation systems have been available on many upscale cars and SUVs, and as aftermarket accessories for the rest of us, for quite some time now. While they offer the promise of never getting lost on unfamiliar streets again, because most require some computer literacy to be used effectively, they often fail to meet that promise. Fortunately, that is now changing thanks to a new type of vehicle navigation system that is replacing the impersonal digital displays and digitized voices of existing systems with friendly, helpful, and live human assistance.

One such system is OnStar, now available on many 1998 General Motors vehicles. OnStar uses a voice-activated digital cellular telephone and the Global Positioning System. There is no display or keyboard. Drivers communicate directly with OnStar Centers in Troy and Farmington Hills, MI.

BILL SIURU

What it Does. OnStar at its heart is a vehicle-navigation system with a human touch. Using GPS, OnStar Center advisors can pinpoint an OnStar-equipped vehicle's location at all times. If you need directions, press the "OC" (OnStar Center) button on the phone to talk to an advisor, who after pinpointing your location, can provide routing to the destination. You can even record instructions to use while driving. The OnStar database contains about 3.2 million listings on everything from airlines to zoos. OnStar can even be used to make reservations at a hotel or restaurant, purchase airline tickets, or send flowers.

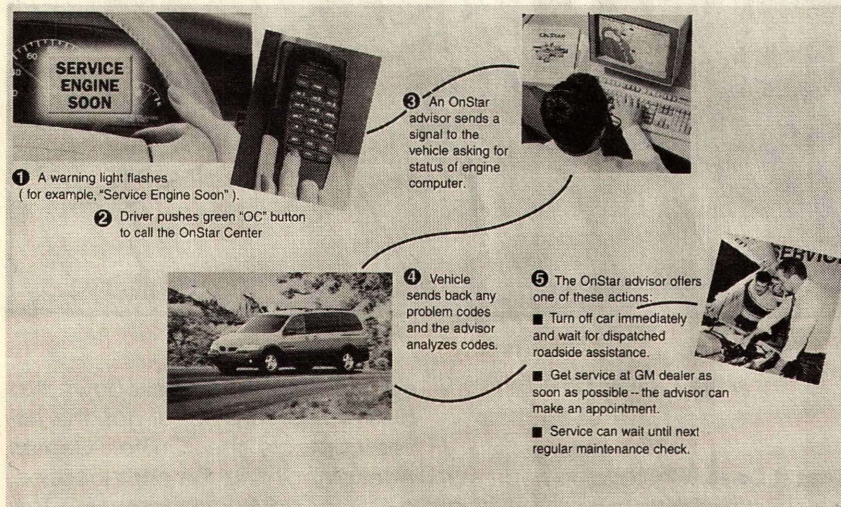
If that's all there were to it, OnStar would be a nice, but far from vital automotive accessory. It's when things go wrong on the road that the true benefits of OnStar become apparent. For example, if an OnStar-

equipped vehicle breaks down, has a flat tire, or runs out of gas, the driver contacts the OnStar Center. After pinpointing the car's location, a Center advisor dispatches a tow truck. If the vehicle is involved in an accident where the airbags deploy—indicating the possibility of a severe crash—without action on the part of the driver OnStar automatically sends that information to the Center, which then dispatches emergency services to the scene.

Should a warning light on the instrument panels start flashing, the driver can contact the OnStar Center where an advisor uses OnStar's Remote Diagnostics to get an immediate analysis of the problem. OnStar advisors can now interrogate 266 system codes covering engine and powertrain, braking, and air bag systems. This includes codes for transmission-fluid temperature, engine misfiring, fuel-injector malfunction, and engine over-temperature protection—indeed more than half of



NEED A HAND while on the road? The OnStar Center is in operation 24-hours-a-day, 365-days-a-year.



IF A WARNING LIGHT FLASHES, the driver alerts the OnStar Center, which then electronically interrogates the vehicle to pinpoint the source of the problem. Using that information, the Center then advises the driver of the best course of action.

all problems that a GM owner might encounter. The advisor can let the driver know what action is needed, which could range from immediately pulling over to the side of the road and turning the engine off to scheduling an appointment at a GM dealer to get the problem checked.

In case of a medical problem or other emergency, the "Emergency" button on the phone is pressed and an advisor goes into action to alert the nearest emergency-services provider—police, fire department, or ambulance—giving information on the type of emergency, condition of the caller, and exact location.

one has locked their keys inside the car. With OnStar, if it happens to you there is an easy solution. You can make a toll-free telephone call to the OnStar Center. After verifying the caller's identity to preclude a theft, an advisor sends a cellular message to the car's electronic-lock system to unlock the door at a specified time. Using an agreed upon time for unlocking ensures the car is not unlocked before you reach it.

A message can also be sent to the OnStar Center if the theft alarm is tripped. If the car is stolen—indicated by the alarm or a call from the owner—the Center can track the stolen vehicle continuously via

FOR MORE INFORMATION

OnStar

888 W. Big Beaver Road, Suite 200
Troy, MI 48084
Tel: 888-OnStar7
Web: www.onstar.com

GPS and provide that information to the police.

The OnStar Center serves customers 24-hours-a-day and 365-days-a-year. OnStar is available in all 50 states, and soon in Canada, and on all Cadillacs and Buicks; Oldsmobile Aurora and Silhouette; Pontiac Bonneville and Montana; Chevrolet Lumina, Monte Carlo, Tahoe, Venture, Suburban and C/K pickups; and GMC Yukon, Envoy, Denali and Suburban. The additional cost for the unit is less than \$1000, plus there is a service fee added to your monthly cellular-telephone bill.

Different Cars, Similar Systems.

But what if you don't plan to buy a new GM? No problem. Like any good idea, other automakers are offering similar systems. For a couple of years, Ford has been offering the very similar RESCU (Remote Emergency Satellite Cellular Unit) as an option in Lincoln Continentals. Nissan is offering its Infiniti Communicator on its Infiniti Q45 and I30 luxury sedans. Developed for Nissan by Motorola, it includes features such as air-bag deployment notification, roadside assistance, remote assistance, remote door unlock, and stolen-vehicle tracking.

And similar systems are coming for other vehicles. For example, by the time you read this the Clarion Corporation of America will have begun offering Westar's ASSIST services for its all new Clarion AutoPC. Available for theoretically any vehicle, it offers basically the same services including emergency and roadside assistance, operator-assisted navigation, directory and concierge services, remote door unlock, stolen-vehicle recovery, and airbag notification. The AutoPC is the first system that integrates traditional car-audio capabilities with wireless communications, turn-by-turn GPS-based navigation, and many computing functions running on Microsoft Windows CE. Ω

"Free" Energy, Bounceback In Capacitors, and More

IS SOLAR ENERGY "FREE?" THERE SURE SEEMS TO BE QUITE A LOT OF MISUNDERSTANDING ON THAT KEY QUESTION. IT TURNS OUT THAT SOLAR ELECTRICAL ENERGY IS JUST AS "FREE" AS OIL IS. IN EITHER CASE, YOU JUST GO GET SOME AS THERE ARE

pools of oil all over the place; they are only covered up with some rocks and dirt. Then, you'll gather up and concentrate the energy, purify it, convert it to some useful form, and finally transport it to an accessible place.

Your only tiny little trick lies in spending less already-existing energy doing the finding, conversion, purification, and concentration than you will get back. If you get more back than you put in, you have a net primary energy source. If you input more old energy than you get back, you have a secondary energy sink, and an overall net loss. All of which leads us up to an oft-ignored field known as *engineering economics*.

The term "money" can mean many different things to different people. Let us try this definition: *Dollar—The personal use and control of all the deliverable energy in one gallon of gasoline.* You vote for that definition every time you make any withdrawal from your nearby "Texaco" bank.

Using that definition, you could substitute "gallons of gasoline" for "dollars." Thus, if a solar array costs you \$10,000, you can think of it as costing 10,000 gallons of gasoline. If interest is \$1000 per year, that equals a thousand gallons of gasoline. And maintenance is something like nine gallons of gasoline per hour—gallons that are forever gone and hence unavailable for any other use.

Your key question is whether the net

total lifetime new solar energy generated will ever exceed all of the gasoline needed to build, finance, and maintain the array.

If an oil company spends less than a gallon of gas to deliver any new gallon of gas, we say they make a "profit." When they spend more, they have a "loss" and are simply doing the equivalent of destroying gasoline. Overall, I'd guess around a quarter of a gallon of older gas gets spent delivering one new gallon.

From that point of view, virtually all solar electrical power so far is really an energy sink driven by the inefficient misuse of gasoline in disguise. Arguably, a rather strong case can also be made that most nuclear power to date is (and almost certainly will remain) a gross energy sink that is heavily subsidized by gasoline and other conventional fuels.

Now, it is just fine to spend energy on research and development. It's also fine to be temporarily inefficient in the interests of perfecting a future net energy source, provided, of course, that the

target source remains viable. It is also sometimes fine to spend more energy than you'll get back for "Uh, compared to what?" needs.

But failing to recognize the hidden subsidies in any "free" energy "source" is sheer stupidity. So is failing to learn the fundamentals of engineering economics.

A New DAA Phone Interface

The folks at Silicon Laboratories have just come up with a new chip set that makes telephone data access arrangements (DAA) a lot simpler, smaller, and cheaper. But first, let's review exactly what phone interface is all about.

The typical telephone subscriber loop is shown in Fig. 1. It consists of the wires that reach from your nearby central office to your property line. Power is delivered from a -48-volt battery, through a pair of 200-ohm resistors. Green or tip is closer to ground. Red or ring is closer to -48.

Capacitors are chosen to couple two-way or full-duplex audio onto the balanced lines. The balance reduces crosstalk in cables. Your audio can be analog voice, digital data, caller ID tones, dialing touch tones, or other supervisory signals.

Ringin' is done by superimposing very large low-frequency intermittent sinewaves on top of the DC loop. A typical ring signal might be 50 volts at 28 Hz, but can range from 40 to 150 volts rms and from 20 to 40 Hz. Capacitor coupling is usually used to isolate the ring signals.

When on hook, there's around 48 volts on the line. Should any single phone be taken off hook, the voltage drops to around 8 volts. Measuring that voltage gives you a simple "the line is in use" detector.

What is the maximum power you can take off the phone lines? If you match the source impedance on a short distance

NEED HELP?

Phone or write all your US Tech Musings questions to:

Don Lancaster
Synergetics
Box 809-EN
Thatcher AZ, 85552
Tel: 520-428-4073

US email: don@tinaja.com
Web page: <http://www.tinaja.com>

new from DON LANCASTER

ACTIVE FILTER COOKBOOK

The sixteenth (!) printing of Don's bible on analog op-amp lowpass, bandpass, and highpass active filters. De-mystified instant designs. **\$28.50**

RESEARCH INFOPACKS

Don's instant cash-and-carry flat rate consulting service. Ask any reasonable technical question for a detailed analysis and complete report. See www.tinaja.com/info01 for specifics. **\$79.00**

CMOS AND TTL COOKBOOKS

Millions of copies in print worldwide. THE two books for digital integrated circuit fundamentals. About as hands-on as you can get. **\$28.50** each.

INCREDIBLE SECRET MONEY MACHINE II

Updated 2nd edition of Don's classic on setting up your own technical or craft venture. **\$18.50**

LANCASTER CLASSICS LIBRARY

Don's best early stuff at a bargain price. Includes the CMOS Cookbook, The TTL Cookbook, Active Filter Cookbook, PostScript video, Case Against Patents, Incredible Secret Money Machine II, and Hardware Hacker II reprints. **\$119.50**

LOTS OF OTHER GOODIES

Tech Musings V or VI	\$24.50
Ask the Guru I or II or III	\$24.50
Hardware Hacker II, III or IV	\$24.50
Micro Cookbook I	\$19.50
PostScript Beginner Stuff	\$29.50
PostScript Show and Tell	\$29.50
PostScript Video & secrets	\$29.50
PostScript Reference II	\$34.50
PostScript Tutorial/Cookbook	\$22.50
PostScript by Example	\$32.50
Understanding PS Programming	\$29.50
PostScript: A Visual Approach	\$22.50
PostScript Program Design	\$24.50
Thinking in PostScript	\$22.50
LaserWriter Reference	\$19.50
Type 1 Font Format	\$16.50
Acrobat Reference	\$24.50
Whole works (all PostScript)	\$380.00
Technical Insider Secrets	FREE

BOOK-ON-DEMAND PUB KIT

Ongoing details on Book-on-demand publishing, a new method of producing books only when and as ordered. Reprints, sources, samples. **\$39.50**

THE CASE AGAINST PATENTS

For most individuals, patents are virtually certain to result in a net loss of sanity, energy, time, and money. This reprint set shows you Don's tested and proven real-world alternatives. **\$28.50**

BLATANT OPPORTUNIST I

The reprints from all Don's Midnight Engineering columns. Includes a broad range of real world, proven coverage on small scale technical startup ventures. Stuff you can use right now. **\$24.50**

RESOURCE BIN I

A complete collection of all Don's Nuts & Volts columns to date, including a new index and his master names and numbers list. **\$24.50**

FREE SAMPLES

Check Don's Guru's Lair at <http://www.tinaja.com> for interactive catalogs and online samples of Don's unique products. Searchable reprints and reference resources, too. Tech help, hot links to cool sites, consultants. email: don@tinaja.com
FREE US VOICE HELPLINE VISA/MC

SYNERGETICS
Box 809-EN
Thatcher, AZ 85552
(520) 428-4073

FREE catalog: <http://www.tinaja.com>

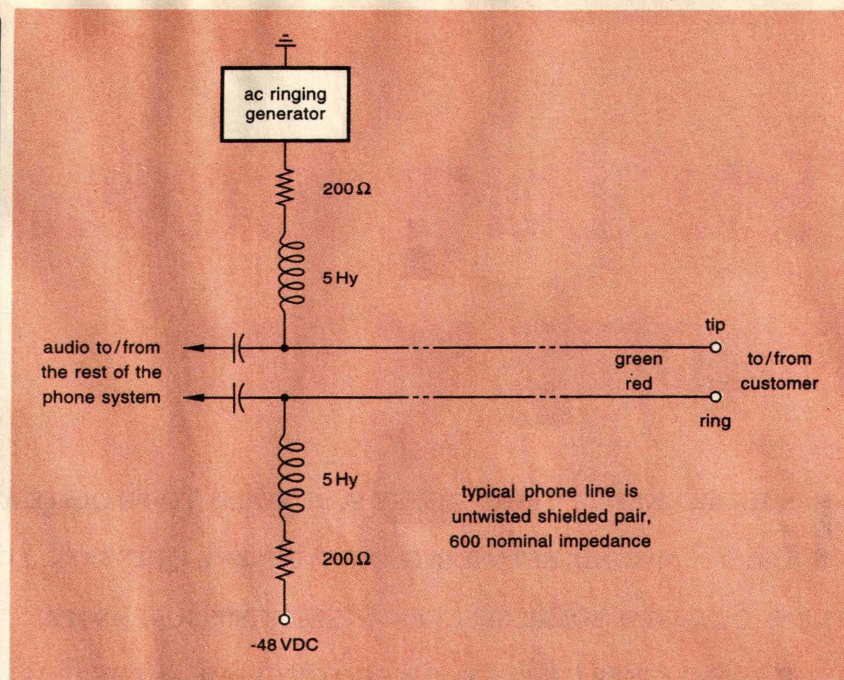


FIG. 1—HERE'S A SIMPLIFIED SCHEMATIC of a telephone local subscriber loop.

line, it is something just over one watt. If you use the load the phone company wants you to on a longer line, then something closer to half of a watt or so is available. All your local phone equipment has to share that meager power, unless they somehow access internal batteries or AC power connections.

The FCC places very strict rules on what you can and cannot do to the phone line. These rules appear in Part 68 of Title 47 of their *CFR Code of Federal Regulations*. That CFR web site is www.access.gpo.gov/nara/cfr. A CD with the full CFR is available from Solutions Software for \$62.50.

Just being compliant with the rules is not enough. You also have to go through a very costly and gruesome certification process on all commercial gear. Yes, "pass through" certifications are sometimes available if you use a pre-approved module in a permitted manner inside your own product.

An older DAA interface appears in Fig. 2. We looked into Part 68 interface circuits way back in HACK61.PDF (March 1993 and available on my www.tinaja.com Web site) and HACK07. PDF, and in the Hardware Hacker reprints.

The key component is the isolation transformer. It is a 1:1 ratio unit with an impedance of 600 ohms and a 1500-volt breakdown voltage rating. The Part 68 transformers have gotten smaller and cheaper, but they still have to permit a DC primary current and do present size

problems, especially when dealing with PCMCIA and similar cards. Part 68 transformers are found in the usual electronics trade journals and distributors.

Extra bells and whistles have to be added to Fig. 1 to make a full interface. Ring detection is normally done with an AC-linked optocoupler, while a relay's contacts are often used as the hook switch. Some sort of a hybrid, or a two-line to four-line converter, is also needed to separate the incoming and outgoing audio.

There's been several attempts in the past to get rid of the transformer by using high-voltage capacitors. The big "gotcha" here is that the FCC also insists upon a very stringent lateral balance specification. Common-mode signals must be rejected to between 40 and 60 decibels over the audio range.

The Silicon Laboratories approach appears in Fig. 3. They use two integrated circuits, the Si3032A (on your side) and the Si3032B (on the telephone-company side). Those two chips talk to each other by coupling pulses over isolation capacitors. One capacitor is in your signal path; the other two provide balanced ground coupling. All that goes on the phone side is a chip and a few transistors that act as a hook switch. The size is much smaller than any transformer DAA, and easily can fit in a corner of a memory card.

No special ring detection circuitry is needed either. A surprising amount of power can be coupled over their IsoLink technology—enough to power a con-

ventional ringer, even.

It's all done by the chip set. While intended for modems and other data communications uses, there is an analog output. It is intended for call-progress monitoring during your dialing, but there's no obvious reason why you could not build up a phone recorder or other analog application around that output.

Figure 4 shows their usual audio-output circuit. Software poked into registers lets you mute incoming, outgoing, or all audio.

There's quite a bit of innovation involved here. As near as I can tell, a series of locked-pulse frames is set up between their two chips. Those apparently provide two-way data and voice communications, as well as providing the on-hook power for the "B" chip. Extremely elaborate transmit and receive filtering is provided for. That approach also eliminates any need for relays, hybrids, or optocouplers.

The chip set is controlled by an external microprocessor of some sort, which could be a digital signal processor or gate array inside the modem. But you can easily work up a PIC interface.

As with any micro-controlled chip, there will be a dozen or so internal registers that can be read or written to select various options or to input and output data. Full programming details appear on the data sheet.

Cost for the chip set is under \$5 in quantity. Modem speeds up to 57.5 kilobaud are fully supported. A demo board and ready-to-use reference design is also available.

I have gathered a few additional DAA suppliers together for you as this month's resource sidebar. Your essential trade journal here will be *Compliance Engineering*. Secrets of caller ID are found in HACK43.PDF (August 1991 and available on line). Bargains on telephone-line lockouts can be found at www.tinaja.com/barg01.html. Those can prevent "modem blasting" should any extension phone get picked up.

Bounceback and Friends

A lot of webizens sure do end up surprised whenever some capacitor seems to magically acquire a charge and terminal voltage after just sitting around for a while. Those "magic" voltages are often attributed to free energy, extragalactic communication, petrovoltatics, or whatever else happens to be the *Scam Du Jour*.

Uh, of course it turns out there's usually no magic here at all. Chances are the

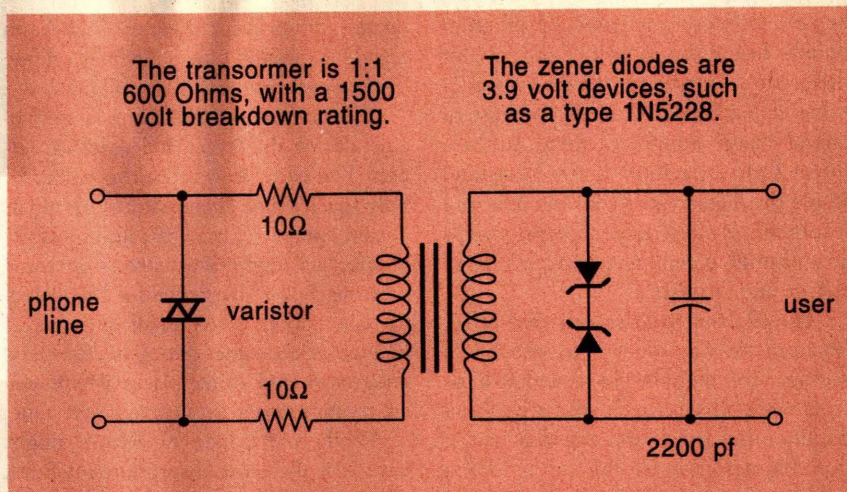


FIG. 2—THIS DATA ACCESS ARRANGEMENT (DAA) uses a special transformer that allows DC primary current.

NAMES AND NUMBERS

Amateur TV Quarterly

5931 Alma Dr.
Rockford, IL 61108
(815) 398-2683

Brand Electronics

421 Hilton Rd.
Whitefield, ME 04353
(888) 433-6600

Hewlett-Packard Journal

3000 Hanover St. M/S 20BH
Palo Alto, CA 94304
(415) 857-1501

HILTI

PO Box 21148
Tulsa, OK 74121
(800) 879-8000

Home Power

PO Box 520
Ashland, OR 97520
(800) 707-6585

Maxim

120 San Gabriel Dr.
Sunnyvale, CA 94086
(800) 998-8800

Microchip Technology

2355 W Chandler Blvd.
Chandler, AZ 85224
(602) 786-7200

Midwest Products

400 S Indiana St.
Hobart, IN 46342
(800) 348-3497

National Semiconductor

2900 Semiconductor Rd.
Santa Clara, CA 95052
(800) 272-9959

Omega Engineering

One Omega Dr.
Stamford, CT 06907
(800) 826-6342

Polycase

1305 Chester Industrial Pkwy.
Avon, OH 44011
(800) 248-1233

QuikVoice

16019 Kaplan Ave.
City of Industry, CA 91744
(626) 333-6394

Robot Science & Technology

2351 Sunset Blvd.
Rocklin, CA 95765
(916) 632-1000

Science/AAAS

1333 H St. NW
Washington, DC 20005
(202) 326-6400

Seiko Instruments

1130 Ringwood Ct.
San Jose, CA 95131
(408) 433-3208

Solutions Software

1795 Turtle Hill Rd.
Enterprise, FL 32725
(407) 321-7912

Synergetics

Box 809
Thatcher, AZ 85552
(520) 428-4073

Ulano Corp

280 Bergen St.
Brooklyn, NY 11217
(718) 622-5200

apparent charge is created by inherent defects inside the capacitor and involve dielectric absorption, which is sometimes called "soak." Basically, because of lateral charge migration, there can be a lot of little capacitors scattered around inside the dielectric of your big one, and it sometimes takes those absorption caps an amazingly long time (even months) to charge and discharge.

The electric utilities call that effect bounceback. Any older large paper and oil capacitor might be charged to 30 kilovolts while in service. It might be thoroughly discharged and shorted out a dozen times. But let the cap sit for a while open circuited, and it may eventually end up with a deadly 3 kilovolts or so of highly unexpected terminal voltage.

Bounceback is sort of a second cousin to electrets and the buried charges in EEPROMS. It's just not quite as permanent.

The bounceback effect can be demonstrated using a Leyden Jar in a Physics 101 lecture. But let us ask an electrical safety Web site to summarize:

"All high-grade capacitors, if left on an open circuit after discharge, will recover a considerable portion of the original charging energy. Highly dangerous voltages can build up in open-circuited capacitors over a period of many months after they have last been discharged. This is particularly true where inexpensive paper dielectrics have been used."

There is a very simple test to find out which utility linemen remained awake

during Bounceback Lecture #01-A on Day One, Session One of lineman school: They are the ones who are still alive.

The bounceback effect is most noticeable among the larger and older capacitors. The better new capacitors will carefully specify their dielectric absorption as a percentage. Thus 50 millivolts of bounceback might be expected from some previous 5-volt charge with a 1% dielectric absorption. Even small amounts of bounceback becomes critical in dual-slope integrators and other places where you are trying to measure a current over time.

While old paper capacitors might have 10% dielectric absorption, the finest of premium Teflon caps might offer 0.0% bounceback. Half a percent is typical for better mylar caps. Electrolytics in particular are a bizarre witches' brew of chaotic electrochemistry. They should never be used anywhere near any critical low level measurement of any sort.

All of which is not to say that new or unusual measurements cannot be made with capacitors. It is just that you will always have to rigorously eliminate bounceback, because that common and expected effect might end up much stronger than what you think you are measuring.

Another PIC Power Meter

Home energy management starts off Appliance running costs. To help toward that end, I just received a review unit of the Brand Electronics model 4-1850 power meter. This one is in a five-inch square by two-inch high case. Power consumption, total energy used, runtime

hours, plus monthly and average operating costs all is displayed. The costs assume a fixed ten cents per kilowatt-hour. Since many hundreds of samples are taken per half cycle, the ability to handle unusual waveforms and high crest factors seems inherent.

There is a single grounded outlet at the rear. You plug in the appliance whose energy consumption is to be measured, and plug the unit into the wall outlet. List price is \$149.

Power measurement and related home energy monitoring topics often show up in *Home Power* magazine. The Web site is www.homepower.com Circuit details of a reference design for a PIC-based wattmeter are available from Microchip Technology via their www.microchip.com Web site. Lots more on PICs in general is found at www.tinaja.com/picup01.html.

New Tech Lit

From Seiko Instruments, there is a new CD-ROM on all of their components and integrated circuits. From Maxim comes a thick new *Product Selector Guide* and CD. Omega Engineering offers a useful free wall chart about infrared measurement fundamentals. QuikVoice has a handy booklet full of solid-state answering-machine and ad-messaging circuits.

Interesting information on photopolymer films is available by way of Ulano. Tiny keychain-sized electronic cases are available from Polycase. Unusual micro-cut woods are stocked in depth by Midwest Products. From HILTI, there's a

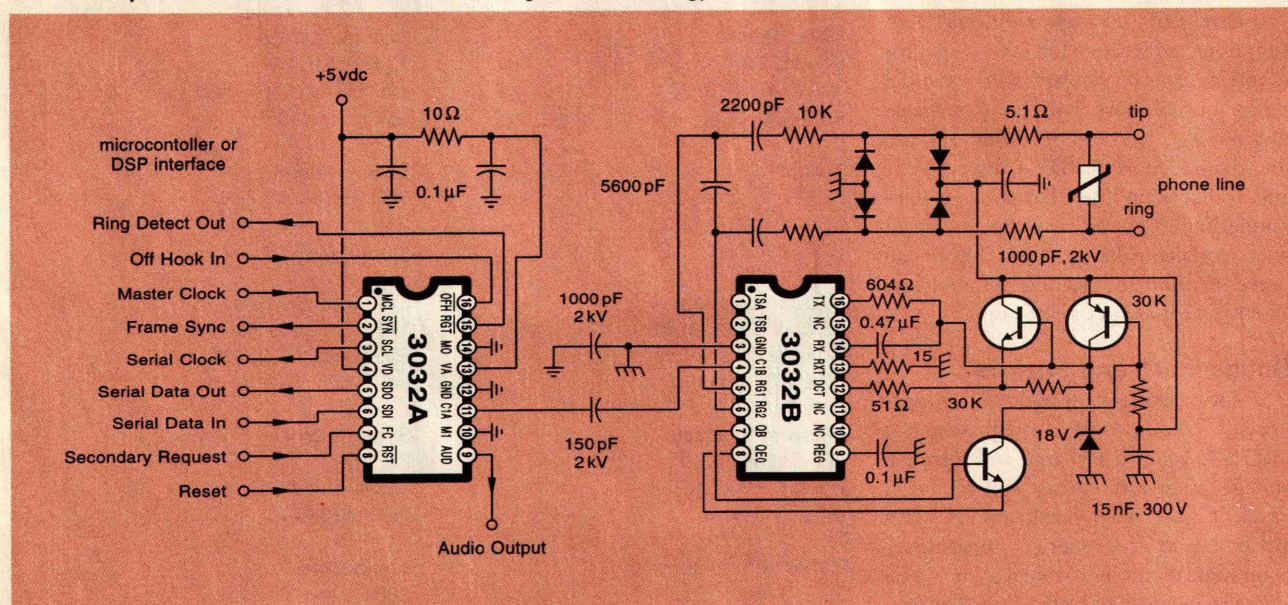


FIG. 3—A NEW DAA FROM SILICON LABORATORIES uses a pair of integrated circuits and balanced coupling capacitors to eliminate the transformer, hybrid, and ring detector.

SOME DATA ACCESS ARRANGEMENT (DAA) RESOURCES

Cermetek

1308 Borregas Ave.
Sunnyvale, CA 94088
(408) 752-5000

Compliance Engineering

1 Tech Drive
Andover, MA 01810
(508) 681-6600

Computer Telephony

12 West 21st Street
New York, NY 10010
(212) 691-8215

Comrex

65 Nonset Path
Acton, MA, 01720
(800) 237-1776

C.P. Clare

78 Cherry Hill Drive
Beverly, MA 01915
(978) 524-6700

Dallas Semiconductor

4401 Beltwood Pkwy. S
Dallas, TX 75244
(972) 371-4000

Harris Semiconductor

1025 West NASA Blvd.
Melbourne, FL 32919-0001
(800) 4-HARRIS

Hello Direct

140 Great Oaks Blvd.
San Jose, CA 95119
(800) HI-HELLO

Lucent Technologies

555 Union Blvd. #21Q-133BA
Allentown, PA 18103
(800) 372-2447

Maxim

120 San Gabriel Dr.
Sunnyvale, CA 94086
(800) 998-8800

Mitel

2321 Morena Blvd. #M
San Diego, CA 92110
(619) 276-3421

Siemens Components

10950 N Tantua Ave.
Cupertino, CA 95014
(408) 777-4968

Silicon Laboratories

2024 E St. Elmo Rd.
Austin, TX 78744
(512) 416-8500

Silicon Systems

14351 Myford Rd.
Tustin, CA 92680
(714) 573-6000

Teltone

22121 20th Ave. SE
Bothell, WA 98021
(800) 426-3926

Xecom

374 Turquoise St.
Milpitas, CA 95035
(408) 945-6640

line of laser instruments to measure, plumb, and level—all at once.

A scheme for directly converting solar energy into hydrogen in a single cell is described in *Science* for April 17, 1998 on pages 382 and 425-427. While the claimed efficiency is an outstanding 12.5%, their economics otherwise are likely to remain poor. Materials similar to those used in LEDs are involved.

Robot Science & Technology is a new robotics magazine published by Mike Greene. The *Amateur Television Quarterly* continues to be a well done labor-of-love newsletter.

Our featured trade journals include *PC-AI* on computer-based artificial intelligence. Plus let's give a mention to the good old *Hewlett-Packard Journal*.

Free chip samples for this month are the CLC5523 250-MHz low-power variable-gain amplifier from National Semiconductor. Plus a new S-8430AF combination step-up and step-down regulator from Seiko Instruments. Lots of great buys on Tektronics scopes and Ethernet cards can be found at www.tinaja.com/barg01.html.

Once you get beyond its obviously redundant title, *Windows Annoyances* is a really great book. Lots of useful tips here on speeding things up and reducing frustration. David Karp is the author. It sells for \$29.95. Irvin Glassman's *Combustion* is apparently the definitive university text on everything involving flames. I have access to these titles and a full power search for just about any other book (technical or otherwise) at www.tinaja.com/amlink01.html.

To receive instant and thorough answers to any technical subject, check out my new InfoPack service at www.tinaja.com/info01.html. And the insider secrets of active filters are found in my *Active Filter Cookbook*, per my nearby Synergetics ad.

The latest additions to my Guru's Lair Web site at www.tinaja.com now include a new tutorial on cubic spline curve fitting, several of the latest newly discovered and delta-friendly magic sinewave sequences, plus a tutorial about offshore electronics resources. A new site search has also been added.

A reminder that most of the text-mentioned items appear in our Names and Numbers and DAA Resources sidebars. Always check here before calling our free US technical help line shown in the nearby box.

Let's hear from you.

September 1998, Electronics Now

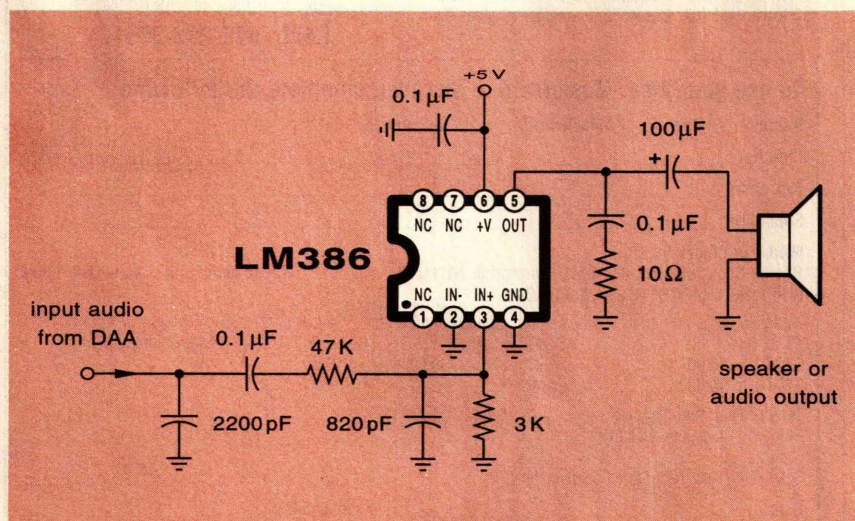


FIG. 4—THE DAA AUDIO OUTPUT CIRCUIT shown here can be used for digital call-progress monitoring or analog message recording.

DISPLAYER

(continued from page 60)

get into places you don't want them to be. Ground the shield at the PC board end only to prevent any ground loops.

As you flip the switch, you should see the appropriate "C" LED light dimly to indicate where middle C is. The note display should track correspondingly.

The volume display is easy to test. Connect the output of an instrument to J3 and play it at maximum volume. Adjust R42 until the last light is lit. The DisPlayer is now calibrated and ready to go.

If you want to check the operation of the temperature-compensating circuit, briefly touch a soldering iron to the case of Q1 while a constant frequency is being displayed. You'll see that the frequency display change rapidly as the transistor warms up even slightly. Now warm up Q2; you'll see the same change, but in the opposite direction.

Other Uses for the DisPlayer. One simple modification that will make the DisPlayer easy to use for a variety of pitch-sensing purposes would be to use panel-mount pots for R41-R44 as was done in the author's prototype. That will make it easier to re-adjust the DisPlayer to any particular situation.

There's no reason why you couldn't experiment with 11- or 13-note scales. Simply set up the pitch calibration so that one octave is covered by 11 or 13 lights. It will be somewhat confusing because the display will still apparently show 12 notes per octave, but the music you produce with such scales will be very different.

The input to the logarithmic op-amp can be just about anything you want. For example, a super-expanded VU meter can be created by disconnecting R15 from the output of IC5 and using it as a direct input to your signal source (either AC or DC). Each light will represent 0.5 dB, for a total dynamic range of 20 dB. If your input is from a light meter, you can adjust the display so that each LED could represent $1/12$ of an f-stop—a boon to photographers.

Happy DisPlayer-ing!

Ω

Electronics NOW

REPRINT BOOKSTORE

- | | |
|---|---|
| ☐ 228 Popular Electronics (1998 back issues) \$5.00
Write in Issues desired | ☐ 216 Electronics Now (1996 back issues) \$5.00
Write in Issues desired |
| ☐ 227 Popular Electronics (1997 back issues) \$5.00
Write in Issues desired | ☐ 215 Electronics Now (1995 back issues) \$5.00
Write in Issues desired |
| ☐ 226 Popular Electronics (1996 back issues) \$5.00
Write in Issues desired | ☐ 214 Electronics Now (1994 back issues) \$5.00
Write in Issues desired |
| ☐ 225 Popular Electronics (1995 back issues) \$5.00
Write in Issues desired | ☐ 213 Radio Electronics/Electronics Now (1993 back issues) \$5.00
Write in Issues desired |
| ☐ 224 Popular Electronics (1994 back issues) \$5.00
Write in Issues desired | |
| ☐ 223 Popular Electronics (1993 back issues) \$5.00
Write in Issues desired | |
| ☐ EH95S Experimenters Handbook Summer Edition (1995) \$5.00 | ☐ 174 Electronics Cartoons (The Best of) \$2.00 |
| ☐ EH94S Experimenters Handbook Summer Edition (1994) \$5.00 | ☐ 173 From Not-Working to Networking Troubleshooting Local-Area Networks \$5.00 |
| ☐ EH95W Experimenters Handbook Winter Edition (1994) \$5.00 | ☐ 172 33 Bench-Tested Circuits \$2.00 |
| ☐ EH94 Experimenters Handbook (1994) \$5.00 | ☐ 171 36 Time Tested Circuits \$2.00 |
| ☐ EH93 Experimenters Handbook (1993) \$5.00 | ☐ 170 High-Voltage Project for Fun and Science Book 1 \$4.00 |
| ☐ HH95S Hobbyists Handbook Spring Edition (1995) \$5.00 | ☐ 170A High-Voltage Projects for Fun and Science Book 2 \$4.00 |
| ☐ HH95F Hobbyists Handbook Fall Edition (1995) \$5.00 | ☐ 169 Think Tank (133 Circuits) \$3.50 |
| ☐ HH94S Hobbyists Handbook Spring Edition (1994) \$5.00 | ☐ 169A Think Tank Vol. 2 \$3.00 |
| ☐ HH94F Hobbyists Handbook Fall Edition (1994) \$5.00 | ☐ 168 Fact Cards (#34-66) \$4.00 |
| ☐ HH93 Hobbyists Handbook (1993) \$5.00 | ☐ 168C Fact Cards (#67-99) \$3.50 |
| ☐ HISTORY Crystal Radio History, Fundamentals & Design \$10.95 | ☐ 168D Fact Cards (#100-132) \$3.50 |
| ☐ XTAL Crystal Set Handbook \$10.95 | ☐ 167 Designing With IC's \$4.00 |
| ☐ XTALPRO Crystal Set Projects \$14.95 | ☐ 166 Collected Works of Mohammed Ullyses Fips (62 pages, April Fools Collection) \$12.00 |
| ☐ XTALBLD Crystal Set Building \$15.95 | ☐ 165 How to Repair CD Disc Players \$5.00 |
| ☐ POP POPtronix Hobbyist Handbook (1996) \$5.00 | ☐ 164 Modern Electrics (April 1908) \$3.00 |
| ☐ POP97 POPtronix Exper Handbook (1997) \$5.00 | ☐ 160 New Ideas - 42 Circuits \$3.50 |
| ☐ Radiocraft 1993 Projects for Hobbyists \$5.00 | ☐ 159 Low Frequency Receiving Techniques Building and Using VLF Antennas \$5.00 |
| ☐ 218 Electronics Now (1998 back issues) \$5.00
Write in Issues desired | ☐ 158 Electro Importing Co. Catalog (Circa 1918) \$5.95 |
| ☐ 217 Electronics Now (1997 back issues) \$5.00
Write in Issues desired | ☐ 157 All About Kits \$2.00 |
| | ☐ 156 How To Make PC Boards \$2.00 |
| | ☐ 154 How To Repair VCR's \$3.50 |

To order any of the items indicated above, check off the ones you want. Complete the order form below, include your payment, check or money order (DO NOT SEND CASH), payable to and mail to Claggk Inc., Reprint Department, P.O. Box 4099, Farmingdale, NY 11735.

Please allow 4-6 weeks for delivery. No COD's!

To place a credit card by phone, Visa Mastercard or Discover only. You can also order and pay by e-mail. Contact Claggk@gernsback.com for details.

CALL: 516-293-3751.

To use your Visa, Mastercard or Discover, complete the following:

Bill my ☐ Visa ☐ Mastercard ☐ Discover

Card No. _____

Exp. Date _____

Signature _____

MAIL TO: Claggk Inc.

Reprint Bookstore, P.O. Box 4099, Farmingdale, NY 11735

SHIPPING CHARGES IN USA & CANADA

Up to \$5.00	\$2.00	\$30.01 to 40.00	\$6.00	Overseas Orders must contact
\$5.01 to \$10.00	\$3.00	\$40.01	\$7.00	CLAGGK for shipping charges.
\$10.01 to 20.00	\$4.00	\$50.01 and above	\$8.50	
\$20.01 to 30.00	\$5.00			

Total price of merchandise \$ _____

Shipping Charge (see chart) \$ _____

Subtotal \$ _____

Sales Tax (New York State Residents only) \$ _____

Name _____ Total Enclosed \$ _____

Address _____

City _____ State _____ Zip _____

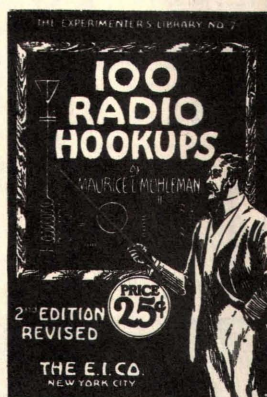
Electronic SHOPPER

Paperback Books

GREAT BOOKS AT BUDGET PRICES

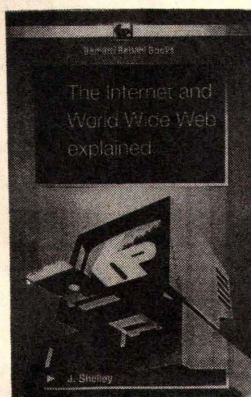
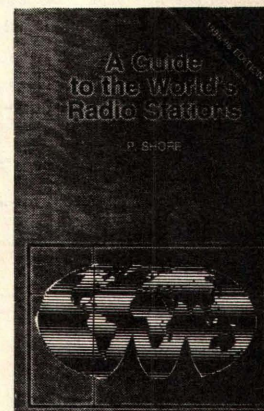
☐ **100 RADIO HOOKUPS**
—#7—\$3.00

First published in May, 1923 this popular booklet went into reprint editions nine times. It is packed with circuits, theory, antenna installation and tips on consumer radio receivers that were popular in the early 1920's. Antique radio buffs and those inquisitive about the early days of radio will find this booklet an exciting, invaluable and excellent reference into the minds of early-day radio listeners. Sorry, we cannot honor the original 25-cent cover price.



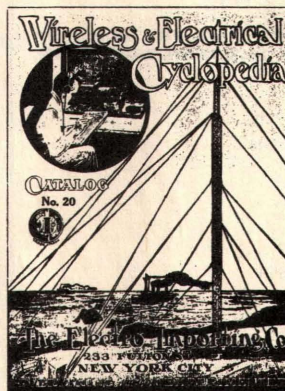
☐ **GUIDE TO THE WORLD'S RADIO STATIONS**
—BP355—\$10.99

An easy-to-read guide for the casual listener and top notch QSL getter! The Guide is an essential reference work designed to steer the listener around the ever more complex radio bands. Listings cover world-wide shortwave stations with a special emphasis on international broadcasts in English. Medium and long-wave listings are also included for the US, Canada, European, Middle and Near East, and North Africa regions



☐ **THE INTERNET AND WORLD WIDE WEB EXPLAINED** —BP403—
\$10.99

Strip away the hype and mystery of the WWW and you'll be cruising on the information Superhighway! Understand the jargon used: ftp, protocols, TCP, hypertext, http, URL, home pages, threads, HTML, domains, FAQs, etc. Discover that e-mail is easy, fast and free! Learn how to guard against hackers and viruses. Develop friendships and "buddies" in Singapore, India, Cape Town, Peru—just about anywhere!



☐ **WIRELESS & ELECTRICAL CYCLOPEDIA**
—ETT1—\$5.75

A slice of history. This early electronics catalog was issued in 1918. It consists of 176 pages that document the early history of electricity, radio and electronics. It was the "bible" of the electrical experimenter of the period. Take a look at history and see how far we have come. And by the way, don't try to order any of the radio parts and receivers shown, it's very unlikely that it will be available.

ELECTRONIC TECHNOLOGY TODAY INC.
P.O. BOX 240, Massapequa, NY 11762-0240

Name _____
Address _____
City _____ State _____ Zip _____

SHIPPING CHARGES IN USA AND CANADA	
\$0.01 to \$5.00	\$2.00
\$5.01 to \$10.00	\$3.00
\$10.01 to 20.00	\$4.00
\$20.01 to 30.00	\$5.00
\$30.01 to 40.00	\$6.00
\$40.01 to 50.00	\$7.00
\$50.01 and above	\$8.50

SORRY No orders accepted
outside of USA & Canada

Total price of merchandise	\$ _____
Shipping (see chart)	\$ _____
Subtotal	\$ _____
Sales Tax (NYS only)	\$ _____
Total Enclosed	\$ _____

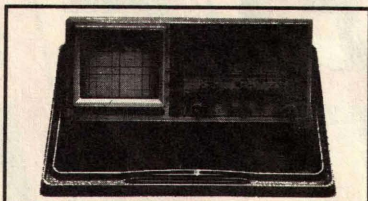
All payments must be in U.S. funds!

Number of books ordered ☐

ET01

New and Pre-Owned Test Equipment

Goldstar



Model OS-9100P → \$899.00

Full 100 MHz Bandwidth!

- Dual-Channel, High Sensitivity
- TV Synchronization Trigger
- Calibrated Delayed Sweep
- Includes Two Probes, 2 Year Warranty

**We Buy Surplus
Test Equipment**

Leader CATV Signal Level Meter Model LF 941

- ✓ TV/CATV Coverage from 46 - 870 MHz
- ✓ Video/Audio Carrier Measurements **\$695.00!**

Just Released! → "Series III" Multimeters

Fluke Model 87III \$309.00 !!!

**Spectrum Analyzer
B+K Precision
Model 2625**

- 150kHz - 1050MHz
- 80dB Dynamic Range
- AM/FM demod included

Only \$2,195.00!

Pre-Owned Oscilloscope Specials

Tektronix 2213	60 MHz	\$549.00
Tektronix 2215	60 MHz	\$649.00
Tektronix 465	100 MHz	\$599.00
Tektronix 465B	100 MHz	\$729.00
Tektronix 475	200 MHz	\$829.00
Tektronix 475A	250 MHz	\$1,199.00

- Professionally Refurbished
- Aligned & Calibrated to Original Specifications
- The Industry Standard of Oscilloscopes
- **1 Year Warranty - The Longest Available!!!**

SIMMax

Module Tester

- * Tests 72/30 pin SIMMs
 - * Stand alone/portable
 - * Identifies SIMM properties
 - * 10 built-in tests identify most memory defects
- Only \$599.00!**

See us on the Web!

www.fotronic.com

Test Equipment Depot

A FOTRONIC CORPORATION COMPANY

99 Washington St. Melrose, MA 02176

(781) 665-1400 • FAX (781) 665-0780

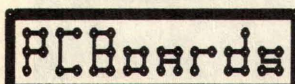
email: afoti@fotronic.com



TOLL FREE 1-800-99-METER

1-800-996-3837

CIRCLE 333 ON FREE INFORMATION CARD



**PCB Artwork
Made Easy!**

PRINTED CIRCUIT DESIGN SOFTWARE

For Windows and DOS

Layout - Autorouting - Schematic - Circuit Simulation

- * NEW 32 bit version available
- * Ripup and Retry Router in Advanced Pkg.
- * Copper Flooding for Building Ground Areas
- * Gerber and Excellon Output
- * Create Negative & Positive Printouts
- * Create Single or Multi Layer Boards
- * Create artwork from the Schematic
- * Analog and Digital Simulation available
- * Make boards up to 32" x 32"
- * Parts Libraries - Silk Layers - Solder Mask
- * Great for All Circuit Design Projects!
- * For the Professional and Hobbyist!

Download Demos from BBS (205)933-2954

Windows™ Version starts at \$149

PCBoards Layout for DOS \$99

Call or Write for Full Product Line, Prices & Free Demo

PCBoards
2110 14th Ave. South
Birmingham, AL 35205

(800)473-7227
Fax (205)933-2954
Phone (205)933-1122

PIC'n Books

LEARN ABOUT PIC16/17 MICROCONTROLLERS

EASY PIC'n Beginner

- Programming techniques
- Instruction set
- Addressing modes
- Bit manipulation
- Subroutines
- Sequencing
- Lookup tables
- Interrupts
- Using a text editor - source code
- Using an assembler
- Timing and counting
- Interfacing - I/O conversion
- Lots of examples

\$29.95

PIC'n Up The Pace Intermediate

- Serial communication
- PIC16 to peripheral chips
- PIC16 to PIC16
- Serial EEPROMS
- LCD interface
- Scanning keypads
- D/A conversion
- Sensors - analog voltage output
- A/D conversion
- Math routines
- Decimal interface
- PIC16F84 EEPROM data memory
- Lots of circuits and code

\$34.95

+ \$4 s/h in US for one book, \$5 both books
VISA, MC, AMEX, MO, Check
CA residents please add 7.25% CA sales tax
PIC is a trademark of Microchip Technology Inc.

SQUARE 1 ELECTRONICS

P.O. Box 501, Kelseyville, CA 95451
Voice (707) 279-8881 FAX (707) 279-8883
Web Site: <http://www.sq-1.com>
E-Mail sqone@pacific.net

**OVER
30,000
ITEMS
IN STOCK**

**LARGE VARIETY
SAME DAY SHIPPING**

Minimum Orders \$20.00

Not Including Shipping & Handling

Dalbani®

The Ultimate Saving Source

SEMICONDUCTORS

Original # Brand Replaces

7805	Tesla	960
7806	Ank	962
7809	Ank	1910
7810	Samsung	1968
7812	Tesla	966
7815	Tesla	968
7818	Tesla	958
7824	Tesla	972
7905	Tesla	961
7906	Tesla	963
7908	Tesla	965
7912	Ank	967
7918	Tesla	959
7924	Tesla	971

YOUR CHOICE

45¢

each

POPULAR FUSE KIT 180 Piece Kit

Kit Contains 10 Pieces of each of these items:

- AGC Type : 0.5A, 1A, 1.5A, 2A, 2.5A, 3A, 4A, 5A, 6A, 10A, 15A
- Ceramic Type : 15A
- GMA Type : 1A, 1.5A, 2A, 3A, 4A, 5A

Everything Comes in a Durable Plastic Box

Item # 10-2050

TUN-O-WASH® (CFC Free)

Fast drying electronics grade cleaner for tuners, controls and PC boards.

- CFC and HCFC free
- Not for use on energized equipment
- * Due to the chemical content, this product can be only shipped by UPS ground service.

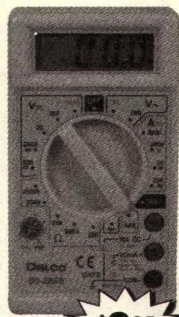
Item # 30-0100

(12.5 Oz aerosol)

DALCO DIGITAL MULTIMETER

- DC Voltage: 200m-1K
- AC Voltage: 200-750V
- DC Current: 20m-20
- Transistor and Diode Test
- Continuity Buzzer
- Polarity indicator appears on LCD
- Test Probes Included
- Dimensions: 4.96" x 2.76" x 9.4"
- Weight: 6 oz.
- 9V Battery Included

Item # 50-2895



\$9.95

Dalco®

ECONOMICAL SOLDER WICK

- Length: 5 feet
- Width: 0.15"
- Safer Desoldering
- Fast Response

Item # 51-1050

5 Feet



\$1.10

SOLDER ROLL

- 1 LB Spool
- 370° F melting point
- Fastest solder
- Alloy 60/40, tin lead, non corrosive flux, Diam.1.0mm

Item # 51-1005



\$5.49

DUAL HELPING HANDS

- Hold Work in any Position to leave hands free for soldering

Item # 50-1325



\$3.45

SOLDERING IRON

- General Purpose Applications
- 117V AC, 30 Watts

Item # 51-1335



\$3.25

Weller WLC100 SOLDERING STATION

Weller



\$38.90

- Ideal for the professional, serious hobbyist
- Variable power control (5-40W)
- 40W pencil iron and ST# inter changeable tip
- Replaceable heating element
- Cushioned foam grip • Safety guard iron holder
- On/off switch with "power-on" indicator light

Item # 51-1505

SHIP UP TO **5lbs** FOR ONLY

\$3.95



Plus handling & C.O.D. charge if it applies

THE MOST POPULAR VCR ALIGNMENT TOOL KIT

\$24.99



- VCR Head pull
- Retaining ringremover
- Micro screwdriver
- Fitted vinyl Case
- 7 Assorted head & guide aligner
- Dimensions: 9 1/2" (W) X 12 1/4" (L)
- 3 Reverseable screwdrivers (Small-Flat-Phillips)
- Spring hook
- Hex key set
- Soft zippered case

Item # 50-888

HEAVY DUTY COLOR CODED LEADS

- 10 Leads
- 11" Long Wire Lead
- Insulated 11/2" Alligator Clips
- 20 Gauge Wire Size
- Black, Green, Red, Yellow, White

Item # 56-500



\$2.95

Dalco® SWING ARM MAGNIFYING LAMP

\$36.72



- Spring-Balanced 45" extension arm with 3 conductor cord 120V 60Hz
- Steel Shade supplied with a precise 3 diopter lens and a 22W fluorescent circline tube
- Comes with a lamp

Item # 54-0120

Dalbani®

4225 NW 72ND AVE. MIAMI, FLORIDA 33166

TEL : (305) 716-1016 ----- FAX : (305) 594-6588

**Free 400 Page Color Catalog
With your First Order**

1-800-325-2264

CIRCLE 234 ON FREE INFORMATION CARD

September 1998, Electronics Now

71

Synthesized FM Stereo Transmitter

Microprocessor controlled for easy frequency programming using DIP switches, no drift, your signal is rock solid all the time - just like the commercial stations. Audio quality is excellent, connect to the line output of any CD player, tape deck or mike mixer and you're on-the-air. Foreign buyers will appreciate the high power output capability of the FM-25; many Caribbean folks use a single FM-25 to cover the whole island! New, improved, clean and hum-free runs on either 12 VDC or 120 VAC. Kit comes complete with case set, whip antenna, 120 VAC power adapter - easy one evening assembly.

FM-25, Synthesized FM Stereo Transmitter Kit \$129.95



Tunable FM Stereo Transmitter

A lower cost alternative to our high performance transmitters. Offers great value, tunable over the 88-108 MHz FM broadcast band, plenty of power and our manual goes into great detail outlining aspects of antennas, transmitting range and the FCC rules and regulations. Connects to any cassette deck, CD player or mixer and you're on-the-air, you'll be amazed at the exceptional audio quality! Runs on internal 9V battery or external power from 5 to 15 VDC, or optional 120 VAC adapter. Add our matching case and whip antenna set for a nice finished look.

FM-10A, Tunable FM Stereo Transmitter Kit \$34.95

CFM, Matching Case and Antenna Set \$14.95

RF Power Booster Amplifier



Add some serious muscle to your signal, boost power up to 1 watt over a frequency range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM Stereo transmitters, providing radio service through an entire town. Power required: 12 to 15 volts DC at 250mA, gain of 38dB at 10 MHz, 10 dB at 1000 MHz. For a neat, professionally finished look, add the optional matching case set.

LPA-1, Power Booster Amplifier Kit \$39.95

CLPA, Matching Case Set for LPA-1 Kit \$14.95

LPA-1WT, Fully Wired LPA-1 with Case \$99.95



Micro FM Wireless Mike

World's smallest FM transmitter. Size of a sugar cube! Uses SMT (Surface Mount Technology) devices and mini electret condenser microphone, even the battery is included. We give you two complete sets of SMT parts to allow for any errors or mishaps-build it carefully and you've got extra SMT parts to build another! Audio quality and pick-up is unbelievable, transmission range up to 300 feet, tunable to anywhere in standard FM band 88 to 108 MHz. 7/8" w x 3/8" h x 3/4" t.

FM-5 Micro FM Wireless Mike Kit \$19.95

Crystal Controlled Wireless Mike



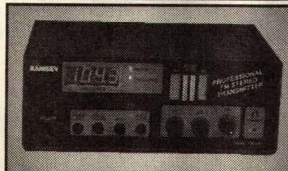
Super stable, drift free, not affected by temperature, metal or your body! Frequency is set by a crystal in the 2 meter Ham band of 146.535 MHz, easily picked up on any scanner radio or 2 meter rig. Changing the crystal to put frequency anywhere in the 140 to 160 MHz range-crystals cost only five or six dollars. Sensitive electret condenser mike picks up whispers anywhere in a room and transmit up to 1/4 mile. Powered by 3 volt Lithium or pair of watch batteries which are included. Uses the latest in SMT surface mount parts and we even include a few extras in case you sneeze and loose a part!

FM-6, Crystal Controlled FM Wireless Mike Kit \$39.95

FM-6WT Fully Wired FM-6 \$69.95

RAMSEY

Super Pro FM Stereo Radio Transmitter



A truly professional frequency synthesized FM Stereo transmitter station in one easy to use, handsome cabinet. Most radio stations require a whole equipment

rack to hold all the features we've packed into the FM-100. Set frequency easily with the Up/Down freq buttons and the big LED digital display. Plus there's input low pass filtering that gives great sound no matter what the source (no more squeals or swishing sounds from cheap CD player inputs!) Peak limiters for maximum 'punch' in your audio - without over modulation, LED bargraph meters for easy setting of audio levels and a built-in mixer with mike and line level inputs. Churches, drive-ins, schools and colleges find the FM-100 to be the answer to their transmitting needs, you will too. No one offers all these features at this price! Kit includes cabinet, whip antenna and 120 VAC supply.

We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.

FM-100, Professional FM Stereo Transmitter Kit \$299.95

FM-100WT, Fully Wired High Power FM-100 \$429.95

AM Band Radio Transmitter



Ramsey AM radio transmitters operate in the standard AM broadcast band and are easily set to any clear channel in your area. Our AM-25, 'pro' version, fully synthesized transmitter features easy frequency setting DIP switches for stable, no-drift frequency control, while being jumper settable for higher power output where regulations allow. The entry-level AM-1 uses a tunable transmit oscillator and runs the maximum 100 milliwatts of power. No FCC license is required, expected range is up to 1/4 mile depending upon antenna and conditions. Transmitters accept standard line-level inputs from tape decks, CD players or mike mixers, and run on 12 volts DC. The Pro AM-25 comes complete with AC power adapter, matching case set and bottom loaded wire antenna. Our entry-level AM-1 has an available matching case and knob set for a finished, professional look.

AM-25 Professional AM Transmitter Kit \$129.95

AM-1 Entry level AM Radio Transmitter Kit \$29.95

Cam Matching Case Set for AM-1 \$14.95

Tone-Grabber Touch Tone Decoder / Reader



Dialed phone numbers, repeater codes, control codes, anywhere touch-

tones are used, your TG-1 will decode and store any number it hears. A simple hook-up to any radio speaker or phone line is all that is required, and since the TG-1 uses a central office quality decoder and microprocessor, it will decode digits at virtually any speed! A 256 digit non-volatile memory stores numbers for 100 years - even with the power turned off, and an 8 digit LED display allows you to scroll through anywhere in memory. To make it easy to pick out numbers and codes, a dash is inserted between any group or set of numbers that were decoded more than 2 seconds apart. The TG-1 runs from any 7 to 15 volt DC power source and is both voltage regulated and crystal controlled for the ultimate in stability. For stand-alone use add our matching case set for a clean, professionally finished project. We have a TG-1 connected up here at the Ramsey factory on the FM Radio. It's fun to see the phone numbers that are dialed on the morning radio show! Although the TG-1 requires less than an evening to assemble (and is fun to build, too!), we offer the TG-1 fully wired and tested in matching case for a special price.

TG-1, Tone Grabber Kit \$99.95

CTG, Matching Case Set for TG-1 Kit \$14.95

TG-1WT, Fully Wired Tone Grabber with Case \$149.95

AC12-5, 12 Volt DC Wall Plug Adapter \$9.95



The Cube World's Smallest TV Transmitter

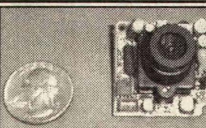
Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies - that's a nickel in the picture! Transmits color or B&W



up to 150' to any TV tuned to cable channel 59 with a solid 20 mW of power. Crystal controlled for no frequency drift with performance that equals law enforcement models that cost hundreds more! Deluxe model includes sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Our cameras shown below have been tested to mate perfectly with The Cube and work great. Fully assembled.

C-2000 Video Transmitter Cube \$89.95

C-3000 Video and Audio Transmitter Cube \$149.95



CCD Video Cameras

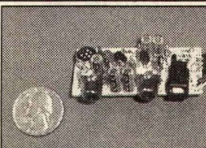
If you're looking for a good quality CCD board camera, stop right here! Our cameras use top quality Japanese Class

'A' CCD arrays, not the off-spec arrays that are found on many other cameras. You see, the Japanese suppliers grade the CCDs at manufacture and some manufacturers end up with the off-grade chips due to either cost constraints or lack of buying 'clout'. These cameras have nice clean fields and excellent light sensitivity, you'll really see the difference, and if you want to see in the dark, these are super IR (Infra-Red) sensitive! Available with Wide-angle (80°) or super slim Pin-hole style lens. Both run on 9 VDC and produce standard 1 volt p-p video. Add one of our transmitter units for wireless transmission to any TV set, or add our Interface board (below) for Audio sound pick-up and direct wire connection to any Video monitor or TV video/audio input jacks. Fully assembled.

CCDWA-2 CCD Camera, wide-angle lens \$99.95

CCDPH-2 CCD Camera, slim fit pin-hole lens \$99.95

IR-1 IR Illuminator Kit \$24.95



CCD Camera Interface Board

Here's a nifty little kit that eases hook-up of your CCD camera module to any video monitor, VCR or video input TV set. The board provides a voltage regulated and filtered source to power the camera (CCD Cameras require a stable source of power for best operation), sensitive electret condenser mike for great sound pick-up and RCA Phone jacks for both audio and video outputs. Runs on 11 - 20 VDC.

IB-1 Interface Board Kit \$14.95

Call for our Free Catalog !

RAMSEY ELECTRONICS, INC.
793 Canning Parkway
Victor, NY 14564

Order Toll-free: 1-800-446-2295

Sorry, no tech info or order status at this number

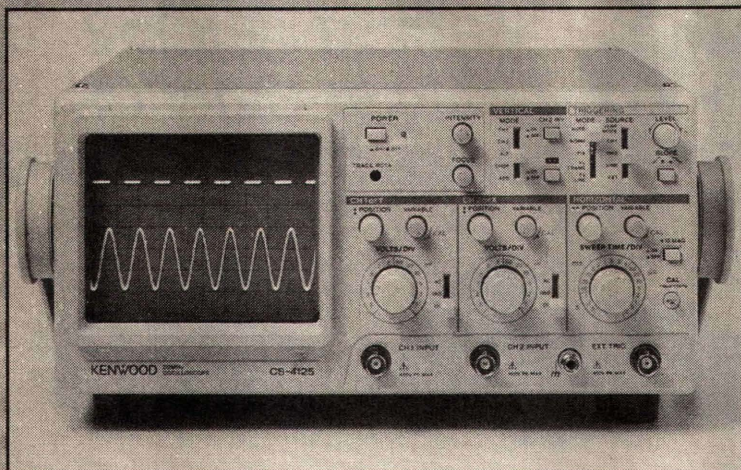
Technical Info, Order Status
Call Factory direct: (716) 924-4560
www.ramseyelectronics.com



ORDERING INFO: Satisfaction Guaranteed. Examine for 10 days, if not pleased, return in original form for refund. Add \$6.95 for shipping, handling and insurance. Orders under \$20, add \$3.00. NY residents add 7% sales tax. Sorry, no CODs. Foreign orders, add 20% for surface mail or use credit card and specify shipping method.

KENWOOD

*...from the company you've
been listening to for years...*

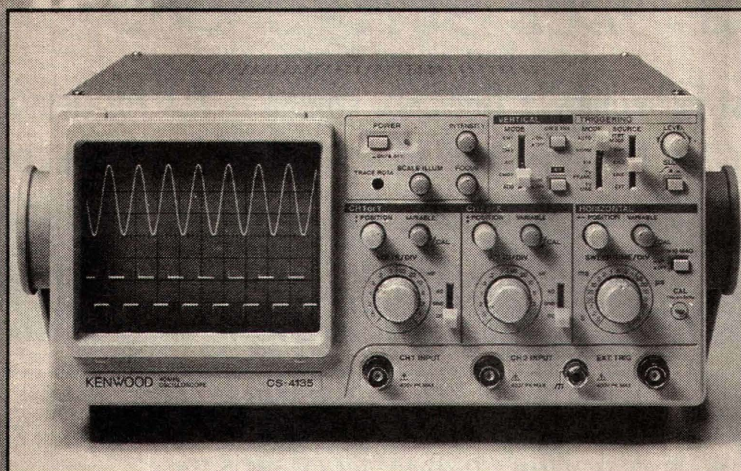


2-Channel, 20-MHz

CS-4125

Regular \$595

Sale \$389



2-Channel, 40-MHz Oscilloscope

CS-4135

Regular \$855

Sale \$685

Hybrid IC Technology is the Key to the High Quality and High Reliability at Low Cost!

- **FIX SYNCHRONIZATION** detects the trigger level automatically for the acquisition of stationary waveforms without complicated sync level adjustments.
- **VERT MODE TRIGGERING** enables the acquisition of stationary waveforms for both CH1 and CH2 even when the input signals to the two channels have different frequencies.
- **HIGH WITHSTAND INPUT** voltage of 400V (800Vp-p).
- **RELAY ATTENUATORS** are provided for reliable logic switchover.
- **SCALE ILLUMINATION** (CS-4135 only)
- **DIMENSIONS** (WxHxD): 300(343) x 140(150) x 415(430)mm () including protrusion.
WEIGHT: approx. 7.2kg (CS-4135) approx. 7kg (CS-4125)



PRINTTM
Products International

*Call for your free 84 page test instrument catalog today!!!
8931 Brookville Road * Silver Spring, Maryland * 20910*

** Phone 800-638-2020 * Fax 800-545-0058 * www.prodintl.com*

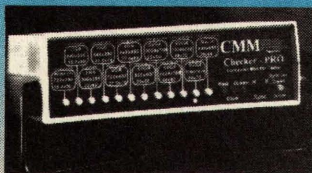
September 1998, Electronics Now

73

CMM

Monitor/TV Test Equipment

Checker Pro



There is the Computer monitor tester you have been asking for. Sweep rates to 15-64 kHz, MGA, CGA, VGA, lots of MACs, even video (mono), GRAY SCALE, quick push button operation, "Energy Star" testing, and more. AC or Battery.

PRICE: \$499.95

Checker 12e



Now you can repair and test Computer monitors with ease. With sweep rates up to 64Khz., eight step gray scale, white screen, single color mode, Mac II, EGA, CGA support, you can run almost ANY PC monitor. And it is EASY to use. Color front panel displays show just what you should see. Don't let its' small size fool you. It is the most powerful handheld available, and it supports ALL basic VGA modes (some don't). It is suitable for bench or field operations. Battery or AC operation.

PRICE: \$295

Checker TV Pro & TV Jr.



The TV Pro is just the tool for your repair bench. It provides Video, S-Video, and RF outputs. It also has the most important pattern, GRAY SCALE! You can't set up a color TV without it. All with NTSC standards and COMPLEX sync. The RF output also includes an audio tone and STEREO signaling. With colorbars, gray scale, crosshatch with dots, you can set and test quickly.

Checker TV Pro...PRICE: \$499.95

The TV Jr. is a small NTSC video generator with colorbars, crosshatch with dots, white, red, blue, green, and black screens. Small enough to fit in your pocket, powerful enough to drive the largest projection TV!

Checker TV Jr....PRICE: \$129.00

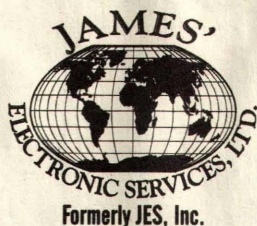
Computer & Monitor

Maintenance, Inc.

1-800-466-4411 • 770-662-5633

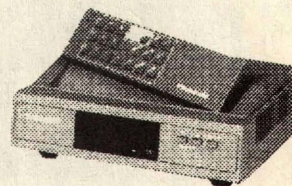
<http://www.computermonitor.com>

ATTENTION DEALERS: WHOLESALE ONLY!



**BEST PRICES!
FAST SERVICE
SAME DAY SHIPPING**

EXCLUSIVE:



2 PIECE SETUPS: \$85⁰⁰

10 lot • 1 Year Warranty

**Latest Technology • Universal Combo's - Ask For Details
CALL US LAST! LOWEST PRICES GUARANTEED!**

**TOLL FREE:
800-322-9690**



**FAX:
516-246-5634**

**ABC ELECTRONICS 315 7TH AVE N. MPLS. MN. 55401
(612)332-2378 FAX (612)332-8481 E-MAILSURP1@VISI.COM
WE BUY TEST EQUIPMENT AND COMPONENTS.
VISIT US ON THE WEB AT WWW.ABCTEST.COM**

HP 8901A MODULATION ANALYZER	\$2100.00	TEK 2465A 350MHZ 4CH. OSCILLOSCOPE	\$3500.00
HP 8165A 50MHZ PROG. SIGNAL SOURCE	\$1700.00	TEK TDS320 100MHZ DIGITAL O-SCOPE	\$1700.00
HP 436A RF POWER METER NO CABLE OR SENSOR	\$700.00	TEK 465 100MHZ OSCILLOSCOPE	\$400.00
HP 8559A/853A .01-21GHZ SPECTRUM ANALYZER	\$3500.00	TEK 475 200MHZ OSCILLOSCOPE	\$500.00
HP 1740A 100MHZ OSCILLOSCOPE	\$250.00	TEK 496P 1KHZ-1.8GHZ SPEC. ANALYZER	\$4000.00
HP 8350B SWEEP OSCILLATOR MAINFRAME	\$2900.00	TEK 576 CURVE TRACER	\$2500.00
HP E3617A 0-60VDC 1AMP DIG. READOUT	\$275.00	TEK CG5001 PROG.O-SCOPE CAL.GEN.	\$2000.00
HP 3325A SYNTHESIZER/FUNCTION GENERATOR	\$1100.00	TEK PS5010 POWER SUPPLY	\$450.00
HP 3325A OPT.01 HIGH STABILITY TIME BASE	\$1350.00	TEK 7L12 SPECTRUM ANALYZER	\$1350.00
HP 6034A 0-60V 10A DIG.DISPLAY	\$900.00	TEK 485 350MHZ OSCILLOSCOPE	\$650.00
HP 5335A 200MHZ COUNTER	\$800.00	TEK 454 100MHZ OSCILLOSCOPE	\$300.00
HP 3488A SWITCH/CONTROLLER	\$550.00	TEK TM5006 POWER FRAME	\$250.00
HP 2804A QUARTZ THERMOMETER	\$300.00	TEK 11A32 400MHZ 2CH AMPLIFIER	\$750.00
HP 4140B PICO-AMP METER/DC VOLTAGE SOURCE	\$3500.00	TEK 11A34 300MHZ 4CH AMPLIFIER	\$900.00
HP 54201A 300MHZ DIG.OSCILLOSCOPE	\$1500.00	TEK 11A52 600MHZ 2CH AMPLIFIER	\$400.00
HP 8011A PULSE GENERATOR	\$250.00	TEK 11A71 1GHZ 1CH AMPLIFIER	\$300.00
HP 3455A DMM	\$250.00	TEK 11302A 500MHZ PROG.O-SCOPE FRAME	\$750.00
HP 3497A DATA ACQUISITION/CONTROL UNIT	\$600.00	TEK 11401 500MHZ PROG.O-SCOPE FRAME	\$750.00
HP 86290A RF PLUG IN 2-18GHZ	\$1200.00	TEK 11402 1GHZ DIG.PROG.O-SCOPE FRAME	\$1000.00
HP 86603A RF PLUG IN 1MHZ-2.6GHZ	\$1700.00	TEK TM506 POWER FRAME	\$100.00
HP 86601A RF PLUG IN .01MHZ-110MHZ	\$400.00	TEK 7104 1GHZ OSCILLOSCOPE FRAME	\$1250.00
HP 86632B AM/FM MODULATION PLUG IN	\$750.00	TEK AM503 CURRENT PROBE AMPLIFIER	\$350.00
HP 1631D LOGIC ANALYZER	\$300.00	TEK 7B92A TIME BASE	\$125.00
HP 8640B OPT.002 1GHZ AM/FM SIGNAL GEN.	\$1400.00	TEK 7S12 SAMPLING PLUG IN	\$350.00

No Calories. No Fat. No Cholesterol.

...NO KIDDING. Our free Consumer Information Catalog serves up over 200 free and low-cost government booklets you can really sink your teeth into.

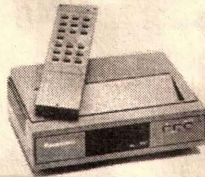
So come 'n get it! Whatever your taste, you can feast on the free Catalog. It's filled with plenty of satisfying booklets. Just call toll-free **1-888-8 PUEBLO**. Or get a bite on the Consumer Information Center website: **www.pueblo.gsa.gov**

WHITE-STAR ELECTRONICS

TEL: 405-631-5153 FAX: 405-631-4788

CONVERTERS:	20	50	100+
Regal CR-83	45	39	35
Panasonic TZPC 175	75	69	65
Centurion CF 3000	65	59	55
Regal CR-83 Volumn	69	65	59

Call for FREE catalog.
405-631-5153



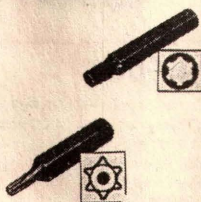
REMOTE CONTROL

HAND UNITS:	20	50	100+
Jerrold Replaces: 400/450/550	4.95	4.50	4.25
Scientific Atlanta: 075/175/475	4.95	4.50	4.25
8600: On screen display	7.50	7.00	6.50
Pioneer: BR 81, 82	4.95	4.50	4.25
Panasonic: Call for model #	7.50	7.00	6.50
Zenith: All	4.95	4.50	4.25
Tocom: 5503-VIP, 5503-A	7.00	6.50	6.25
Universal: 4 in 1 R/M	7.50	7.00	6.50

Call for Oak, Hamlin, Regal-83, Regency, Texscan, and all others.

Tamper-Bit tools: (10-10)

Jerrold compatible bits:	
1/4" Stacom Bit	\$8.00
Oval Round D	\$20.00
Torx Bit:	
Tocom T-8	\$8.00
Zenith T-10, T-15	\$8.00
Pioneer T-20	\$8.00
Scientific Atlanta T-20	\$8.00
Pio 63XX Oval	\$20.00
Bit Driver Handle	\$4.00



We carry most remote hand units. If you don't find the one you're looking for, we can locate for you.

Specializing in large quantities.

HOURS: Monday thru Friday 9 am to 5 pm Central Time.

Call for FREE catalog.
Email: wse405@aol.com

CIRCLE 272 ON FREE INFORMATION CARD

CONTROL MEASURE INPUT

RELAYS • LIGHTS • MOTORS

TEMPERATURE • PRESSURE • LIGHT LEVELS • HUMIDITY

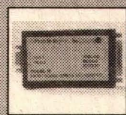
SWITCH POSITIONS • THERMOSTATS • LIQUID LEVELS

MODEL 30 \$79



- PLUGS INTO PC BUS
- 24 LINES DIGITAL I/O
- 6 CHANNEL
- 8 BIT A/D IN
- 12 BIT COUNTER
- UP TO 14K SMP/SEC

MODEL 45 \$189



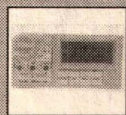
- RS-232 INTERFACE
- 8 DIGITAL I/O
- 8 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

MODEL 100 \$279



- 12 BIT 100 KHZ A/D
- 4 ANALOG OUTPUTS
- 3 TIMER COUNTERS
- 24 DIGITAL I/O

MODEL 150-02 \$179



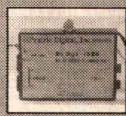
- RS-232 INTERFACE
- TRMS, 20 AMPS
- 12 BIT A/D
- OPTO-ISOLATED
- COMPLETE DMM

MODEL 40 \$99



- RS-232 INTERFACE
- 25 LINES DIGITAL I/O
- 6 ANALOG INPUTS
- PWM OUTPUT

MODEL 70 \$239



- RS-232 INTERFACE
- 18 BIT A/D
- 5.5 DIGIT
- UP TO 60 SMP/SEC

Prairie Digital, Inc.

PHONE 608-643-8599 • FAX 608-643-6754
846 SEVENTEENTH STREET • PRAIRIE DU SAC, WISCONSIN 53578

CIRCLE 215 ON FREE INFORMATION CARD

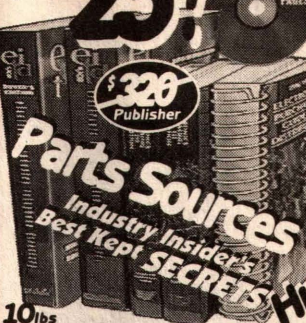
LIQUIDATING WAY Below Cost

as Low as

All 6 PCs \$25!

AMERICAN BUSINESS YELLOW PAGES

\$195 Publisher \$49!



10 lbs Shop the way the Pro's do Use Their Tools!

Lowest Prices Ever!

Find: Distributors, Manufacturers and Service providers for **Products, Services or ANY Component Parts** imaginable from USA & Canada. Sources for Everything from Gears to Semi-conductors to Foreign Assembly Services. Find Products by Description or find ANY Company in the Electronics Industry. Consists of (2vol) Chilton's EITD, (3vol) Springs Technical's EPGD & (1 cd) American Business CD.

BIBLE of the IC INDUSTRY
The Best IC Reference Published. Nothing Else like it in the World! 100,000 ICs of EVERY KIND & Every Manufacturer. Specifications, Selected Data Sheets, Every known Cross-reference, Alternate Sources, Manufacturer Profiles & Distributors. Perfect for Sales, Service, Engineering & Experimenters.

- \$25 ALL 6 Pcs Current Back issues
- \$55 98 Single Edition EITD (Chilton)
- \$117 98 3 Edition EPGD (Springs Tech)
- \$120 98 American Buss CD

- \$49 3 Vol Back Issue of Current Production ICs Perfect for Service & Moderate Design Work
- \$55 Above if Purchased Alone
- \$129 \$195 97 Books, For Advanced Design
- \$159 \$235 97 CD Rom other editions may be available
- \$185 \$195 98 Books
- \$199 \$235 98 CD Rom

SEMICONDUCTOR CROSS REFERENCE & SPEC

Quarter Million Transistors, ICs & Diodes with REFERENCE

A Specialist in "Hard to Cross House Numbers" Easy, Powerful & Fast. The Most Comprehensive Software Sold. A selection yields Device Specifications & 75 to 250 Potential Replacements!

Replacement Numbers are Totally Global including Domestic, Asian, European, House Branded, as well as ECG, NTE, SK & GE. Displays Case Drawings, Lead Configuration & Pin-outs for many Devices. Coverage of Replacement Numbers is Very Impressive. 7 Disk Set (17 Meg decompressed) For DOS, Win3.1 & 95 Latest Version 7.11 Includes Many Helpful Conversion Utilities, Tables & Formulas. Includes: 4 HUGE Consumer Electronics Industry Directories
1- Consumer Electronics Parts Sources (Service) 2- Consumer Electronics Manufacturers 3- The Entire Computer Industry 4- Semiconductor Manufacturers Perfect for Service, Engineering and Purchasing.

EEM Largest Component Parts Directory available. All the Major Parts Manufacturers display Entire Product Line Catalogs with Pictures & Data sheets. Cabinets, Transformers, Pots, Semi's, Resistors, Capacitors, Crystals, Coils, Connectors, Wire, Heat sinks, Switches, Fuses, Speakers, Displays, an Endless list! Makes parts sourcing a snap. The 4 Volume (18 Lb) EEM Set shown is available on CD ROM ONLY.



Bonus Largest Phone Directory Made
\$219 Select Phone
FREE until Aug 31
Deluxe Edition

CHILLING Power What a Deal!
Business, 14 Million!
FREE! alone \$29 \$89 with any item
Bus, Municipal, & Residential
FREE! alone \$39 \$219 with REFERENCE & ICM

All Cards & COD we don't sell semiconductors Sorry, NO catalog
Netcom 800-733-3733 ext 6300 516-826-1808 10-9 EST 7days

CIRCLE 271 ON FREE INFORMATION CARD

September 1998, Electronics Now

CALL TOLL FREE
(800) 292-7711 orders only
Se Habla Español

C&S SALES

EXCELLENCE IN SERVICE

LOOK FOR OTHER
MONTHLY SPECIALS
ON OUR WEBSITE

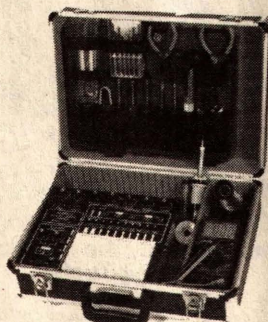
XK-700 Digital / Analog Trainer

Elenco's newest advanced designed Digital / Analog Trainer is specially designed for school projects. It is built on a single PC board for maximum reliability. It includes 5 built-in power supplies, a function generator with continuously sine, triangular and square waveforms and a 1560 tie point breadboard area. Tools and meter shown optional. (Mounted in a professional tool case made of reinforced metal).

XK-700
Assembled and Tested
\$189.⁹⁵

XK-700 - SEMI KIT
w/ Fully Assembled PC Board
\$174.⁹⁵

XK-700K - Kit
\$159.⁹⁵



Made in the USA

Digital Multimeter Model M-1740

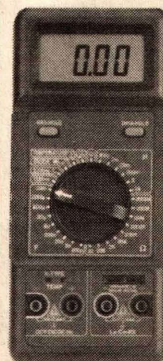
\$39.⁹⁵
Free Holster

- 11 functions
- Freq to 20MHz
- Cap to 20m F
- AC/DC Voltage
- AC/DC Current
- Beeper
- Diode Test
- Transistor Test
- Meets UL-1244 safety specs



DIGITAL LCR METER Model LCR-1810

\$99.⁹⁵



- Capacitance .1pF to 20MF
- Inductance 1μH to 20H
- Resistance .01 to 2000M
- Temperature -20°C to 750°C
- DC Volts 0 - 20V
- Frequency up to 15MHz
- Diode/Audible Continuity Test
- Signal Output Function
- 3 1/2 Digit Display

15pc. VCR Service Tool Kit Model TK-1400

- Inclined Base Screwdriver
- Eccentric Screwdriver
- 2mm & 3mm Fine Adjust Screwdriver
- VHS VCR Head Puller
- Retaining Ring Remover
- 3 Reversible Screwdrivers
- Spring Hook Tool
- Micro Screwdriver
- Hex Wrench Set

Special
\$24.⁹⁵



Model M-6100

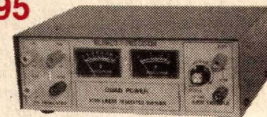
The M-6100 is Elenco's most sophisticated meter with almost every possible feature available. The M-6100 even has a computer interface for viewing and storing data on a personal computer. It comes complete with software, RS-232 cable, test leads and manual.

\$99.⁹⁵

Model XP-581

4 Fully Regulated DC Power Supplies in One Unit
4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A
1 Variable - 2.5 - 20V @ 2A

\$89.⁹⁵



Tektronix DMMs

For high performance digital multimeters that are accurate, reliable, and rugged, the DMM900 series extends the Tektronix line of already affordable DMMs. Twice the accuracy. Up to 10 times the resolution. And a full range of capabilities that span voltage, current, dual numeric display, 3 year warranty, and autoranging capability. All backed by the reliability of the Tektronix brand.



912 \$179
914 \$229
916 \$275

Power Supply Kit Model XP-720K

3 fully reg. DC supplies
1.5VDC - 15VDC @ 1A
-1.5VDC to -15VDC
5VDC @ 3A

Plus
6.3VAC @ 1A and
12.6VAC C.T. @1A

\$54.⁹⁵



Available assembled Model XP-720 \$84.95

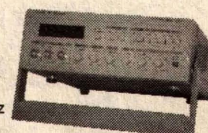
Sweep Function Generator

with built-in Frequency counter

Model GF-8026

\$225

- Range .02Hz - 2MHz
- Sine, Square, Triangle, Pulse, Ramp
- Ext. counter 1Hz - 10MHz



Kit Corner

over 100 kits available

AK-700

\$15.⁹⁵

Phone kit with training course
4 Flashing neon lights
See thru case



RADIO CONTROL CAR KIT MODEL AK-870

- 7 functions
- Remote control included

\$24.⁹⁵

No Soldering Required



Model AM/FM-108K Transistor Radio Kit

with training course

\$29.⁹⁵



Free Stand

35mm Camera Kit Learn all about photography AK-540

\$14.⁹⁵

No Soldering Required



Digital Capacitance Meter Model CM-1555

\$48.⁹⁵

- Capacitors from .1pF to 20M m F
- 3 1/2 Digit LCD
- Zero adjust
- special insertion jack
- 1/2% basic accuracy
- Tilt stand



Digital Audio Generator

with built-in Counter

SG-9300

- 10Hz - 1MHz
- Low Distortion
- Sine/Square waves
- Built-in 150MHz Frequency Counter

\$175



SG-9200 Analog/No counter \$119.95



SATELLITE FINDER Model SF-01

- Aligns Satellite Dishes
- Range 950-2050MHz
- Compact Size
- Self Power Check



\$39.⁹⁵

RF Generator with Counter

Model SG-9500 \$225

- 100KHz - 150MHz
- Internal AM Mod of 1KHz
- RF Output 100MV - 35 MHz
- Audio Output 1KHz @ 1V rms



SG-9000 Analog/No counter \$119.95

WE WILL NOT BE UNDERSOLD C&S SALES, INC.

UPS SHIPPING: 48 STATES 5%
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax

150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710
http://www.elenco.com/cs_sales/



**15 DAY MONEY BACK
GUARANTEE**
FULL FACTORY WARRANTY
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

**Same Day
Shipping**

C & S SALES
Your one stop source for
all your electronic needs!

CALL OR WRITE FOR OUR
**NEW FREE 64 PAGE
CATALOG!**
(800) 445-3201

Fluke Scopemeters



123 NEW \$950
92B \$1445
96B \$1695
97 \$1695
99B NEW \$2095
105B \$2495

**ALL FLUKE
PRODUCTS
ON SALE**

B & K PRECISION SCOPES

20MHz DUAL-TRACE
Model 2120B - 2 Year Warranty

Special \$375

Model 2125A with delayed sweep
\$539.95



- 1mV/division sensitivity
- AUTONORM triggered sweep operation
- AC, TVH, TVV and line coupling
- Calibrated 19 step time-base with x10 magnifier
- Compact low-profile design

Affordable Spectrum Analyzers by B&K



500MHz Series BK2615A **\$1250**
BK2620A **\$1675**

- 150KHz to 500MHz
- Dynamic Range 80dB(113dB with attenuation)
- +20dB maximum input
- 12.5 and 400KHz resolution bandwidth
- 150KHz/hour stability
- Built-in tracking generator(Model 2620A)

1.05GHz Series BK2625A **\$1925**
BK2630A **\$2595**

- 150KHz to 1050MHz
- Dynamic Range 80dB(113dB with attenuation)
- AM & FM demod included
- 20 and 400KHz resolution bandwidth
- 150KHz/hour stability
- Built-in tracking generator(Model 2630A)

PORTABLE SEMICONDUCTOR TESTER

B&K 510

\$199.00



• In or out-of-order circuit tests for transistor, FETs, SCRs and darlingtonts.

20MHz Sweep / Function Generator with Freq Counter

B&K 4040

- 0.2Hz to 20MHz
- AM & FM modulation
- Burst Operation
- External Frequency counter to 30MHz
- Linear and Log sweep

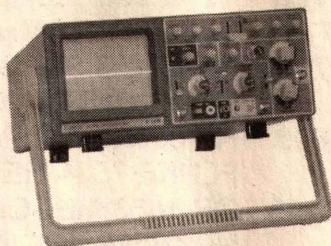


\$399

10MHz B&K 4017 **\$309**
5MHz B&K 4011 **\$239**

Quality Scopes by Elenco

Lowest Prices of the Year!



60MHz

DS-603 \$995

- Analog / Digital Storage
- 20MS/s Sampling Rate
- RS232 Output

S-1360 \$749

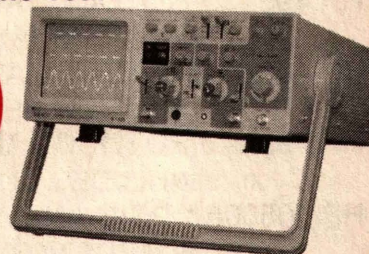
- Analog with Delayed Sweep
- Component Tester

100MHz

S-1390 \$895

- Analog w/ delayed sweep
- Dual Time Base
- TV Sync

**Includes
Free Dust
Cover and
Probes**



25/30MHz

DS-303 30MHz \$895

- Analog / Digital Storage
- 20MS/s Sampling Rate
- RS232 Output

DS-203 20MHz \$695

- Analog / Digital Storage

S-1330 \$439

- 25MHz Analog
- Delayed Sweep

S-1325 \$325

- 25MHz Analog
- TV Sync
- 1mV Sensitivity

**2 Year
Warranty**

Fluke Multimeter Specials



F-73III
\$115

List
\$129



F-75II
\$129

List
\$149



F-79II
\$175

List
\$199



F-87
\$289

List
\$335

B&K Precision Multimeter Specials



- Accurately measures capacitance, resistance and inductance.
- Measures dissipation factor of capacitors and Q of inductors.
- Simultaneously displays measured value and Q or dissipation factor.
- Displays the difference between measures and reference values.

Model 878

\$219.95



- 50,000 count
- 0.025% DCV
- 0.07% ohms
- Min/Max/Avg
- True RMS, AC, or AC+DC
- 100kHz AC response
- Capacitance to 50,000m F
- Frequency, duty cycle, pulse width
- dB across 1 to 10k
- Disturbance indicator
- Autograph, bargraph with zoom
- Sealed case, Splashproof
- IEC 1010, class 2 safety compliance

Model 5390

\$295.00

MX-9300

Four Functions in One Instrument

Features:

- One instrument with four test and measuring systems:
 - 1.3GHz Frequency Counter
 - 2MHz Sweep Function Generator
 - Digital Multimeter
 - Digital Triple Power Supply
- 0-30V @ 3A, 15V @ 1A, 5V @ 2A



\$459.95

GUARANTEED LOWEST PRICES

UPS SHIPPING: 48 STATES 5%
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax

C&S SALES, INC.

150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710
http://www.elenco.com/cs_sales/



**15 DAY MONEY BACK
GUARANTEE**

FULL FACTORY WARRANTY

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

September 1998, Electronics Now

Test Equipment Sales

**LOCATED IN TAX FREE
NEW HAMPSHIRE !!**



HP 4951C PROTOCOL ANALYZER...\$1795
INCLUDES 18173A & NEW CRT
HP 4952A PROTOCOL ANALYZER...\$1795
INCLUDES NEW CRT
HP 4954A PROTOCOL ANALYZER...\$1695
INCLUDES 18135A & 18136A
HP 16500A LOGIC ANALYZER M/F...\$2195
BOARDS VARY IN PRICE
FLUKE 5440B DC VOLTAGE CALIBRATOR
PRICED TO SELL AT.....\$2195
BMI G-111 DATA ACQUISITION BOARD
FOR BMI 4800.....\$295ea.

TEK 2235 100MHz SCOPE.....\$950
TEK 465 100MHz SCOPE.....\$495
HP 8640B SIG.GENERATOR.....\$995
HP 59501B D/A CONVERTER.....\$275
HP 6002A-001 POWER SUPPLY..\$675
FLUKE 752A REF. DIVIDER.....\$1995
GR 1863 MEGOHMMETER.....\$650
HP 1652B LOGIC / SCOPE.....\$3595
HP 1651A LOGIC ANALYZER.....\$1595
HP 339A DIST. ANALYZER.....\$1095
HP 8112A PULSE GENERATOR..\$4295
KEI 619 2 CH. ELECTROMETER..\$995

Ask about our line of new products including
Instek, Fluke, Tektronix and more !

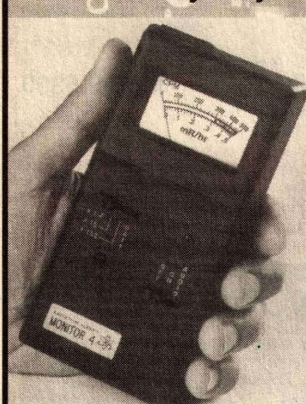
CALL 800 684-4651 OR FAX (603) 425-2945
check out our updated website at WWW.TESALES.COM

CIRCLE 328 ON FREE INFORMATION CARD



QUALITY AT YOUR FINGERTIPS

The easy to build Monitor 4 kit is a cost effective way for you to survey for radiation



**BUILD OR BUY
YOUR OWN
GEIGER
COUNTER**

The finished kit is a sturdy general purpose Geiger counter capable of detecting alpha, beta, gamma, and x-rays. Kit price \$160.00



S.E. International, Inc.
P.O. Box 39
Summertown, TN 38483-0039
Tel: 800-293-5759 Fax: 931-964-3564
E-mail: seiinc@usit.net Website: seintl.com

BOSSMAN ELECTRONICS

IN THE 2000 OLYMPIC CITY OF SYDNEY, AUSTRALIA
PH 011 61 2 95843562 Fax 011 61 2 95841031 All prices US\$
Typical Insured airmail \$10-\$20 Payment by major credit cards only

APOLOGIES TO ALL In our past advertisements we had some mistakes in our contact details. They have now been rectified & our web page is up & running.

CCD CAMERA SPECIAL FREE BONUS \$55 Low light, high Resolution CCD Camera. Very IR Responsive. Two versions NTSC (us) Or PAL (European) Compatible. **PLUS A FREE VHF (US.ch 3-4) VIDEO MODULATOR**

10 LED & 30 LED IR ILLUMINATORS
10 LED \$8
30 LED \$16

LASER DIODE POINTER (Key-chain) Very bright (650 nm) Pointer. Supplied with 4 extra lens caps that Produce Symbols: CUPID, I LOVE YOU, LOVE HEARTS & A LADY. \$22
LASER DIODE MODULE Same quality module That is used in the Above laser pointer: \$18

UHF DATA TRANSMISSION Stamp sized Xtal locked 433.9MHz superhetrodyne receiver module \$20
Small matching transmitter kit: \$9

MINIATURE FM TRANSMITTER (33x23x10mm) 88 to 108-MHz (adj.) Metal case, switch, Microphone & wire ant. Bat. life 60 hrs, Range 50M: (G14) \$39 (Std. Watch battery LR44, inc.)

4 or 6A Peltier Effect COOLER / HEATER 3.3A @14V \$20, 6A @15V \$26, approx. 40X40X4mm, temp. can be controlled by supply voltage / current, will work @1.5V. We supply Peltier, data & application notes

NIGHT VISION TUBE + SUPPLY Used 25mm fiber optic tube plus an EHT power supply kit to suit. With small side blemish.

HIGH POWER HIGH FREQ. EHT Plasma discharge in a std. light bulb, or make a JACOBS LADDER or LADEN JAR & other high voltage EHT applications. application notes. Requires 12V @ 0.5-2A
\$24

*******MORE KITS*MORE KITS*******
Two channel UHF remote control: \$35...
Computer stepper motor driver + software: \$25...New!!! Improved dog silencer: \$28...Alcohol breath tester: \$32...Geiger counter: \$32...Auto-matic laser light show: \$50

www.world.net/~bossman

Any waveform you want!



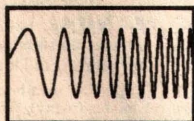
Starting at

\$795

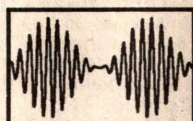
Quantity 1

Money back guarantee

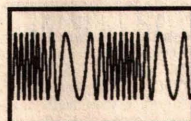
Telulex Inc. model SG-100



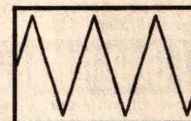
DC to 20 MHz linear and log sweeps



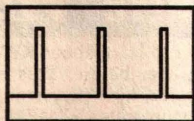
Int/Ext AM, SSB, Dualtone Gen.



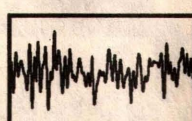
Int/Ext FM, PM, BPSK, Burst



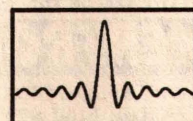
Ramps, Triangles, Exponentials



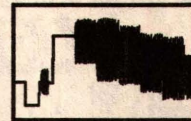
Pulse Generator



Noise



Arbitrary Waveforms



Unlimited Possibilities!

● Synthesized Signal Generator

Clean sinewaves DC-20 MHz with .001% accuracy! .1 Hz steps. DC Offset. RS232 remote control.

● Arbitrary Waveform Generator

40 Megasamples/Second. 32,768 points. 12 bit DAC

● Function Generator

Ramps, Triangles, Exponentials & more to 2 MHz!

● Pulse Generator

Digital waveforms with adjustable duty cycle

Telulex Inc.

2455 Old Middlefield Way S Tel (650) 938-0240 <http://www.Telulex.com>

Mountain View, CA 94043 Fax (650) 938-0241 Email: sales@Telulex.com

CIRCLE 311 ON FREE INFORMATION CARD

Projects, Design Ideas... DIY AUDIO BOOKS

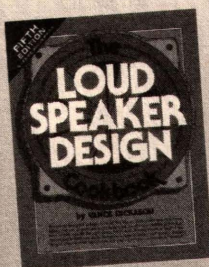
AND MORE FROM OLD COLONY SOUND LAB



Loudspeaker Design Cookbook by Vance Dickason

Fifth edition of the DIY loudspeaker "bible" includes information on home theater and car audio! Over 50,000 copies in print in six languages!

BKAA2-V \$34.95



Beginner's Guide to Tube Audio Design by Bruce Rozenblit

Terrific introduction to designing audio circuits with tubes, de-mystifies this old and new-again technology!

BKAA42 \$24.95



NEW! Testing Loudspeakers by Joseph D'Appolito

Everything you need to know about loudspeaker testing from the why to the how. Covers the full range of measurement systems from analog to PC-based systems.

BKAA45 \$34.95

Call toll-free 1-888-924-9465

ENS98

☐ Send me my FREE copy of the OLD COLONY SOUND LAB catalog!

• BOOKS • TEST CDS • SOFTWARE • PC BOARDS • KITS •

NAME

STREET & NO.

CITY

STATE

ZIP

AUDIO AMATEUR INC., PO BOX 876, PETERBOROUGH, NH 03458-0876 FAX TO 603-924-9467



AUTOMATIC TELLER MACHINES

ATM crimes, abuses, vulnerabilities and defeats exposed! 100+ methods detailed, includes: Physical, Reg. E, cipher, PIN compromise, card counterfeiting, magnetic stripe, false front, TEM-PEST, tapping, spoofing, inside job, vibration, pulse, high voltage - others, con jobs. Histories, law, security checklist, internal photos, figures. Much more! \$39.

CELLPHONE MODIF. GUIDE

How cellphones operate and are modified. Vulnerabilities to hack attack and countermeasures. Details on programming NAMS, ESNs, etc (cloning), control data formats, computing encoded MINs, ESNs, SIDHs, operating systems, PROM programming, forcing ACK, test mode and resets, cable diagrams, scanning, tracking, scanner restorations, freq allocations, roaming, Step-by-steps to keypad-reprogram 100+ popular cellphones. More! \$49.

PAGER / BEEPER MANUAL

How Pagers work, different types and uses, freqs, advantages over and uses with cellphones, and tips and tricks. How Pagers are hacked/countermeasures. And plans for a **Personal Pocket Paging System** (xmitter and receiver). More! \$29.

PHREAKING CALLER ID & ANI

How they work and dozens of ways of defeating Caller ID, ANI, *69, *57, Call Blocking, *67 etc. Describes ESS, SS7, CN/A, CAMA, DNR, Diverters, Centrex - more! \$19.

SECRETS OF SOLDERLESS BREADBOARDS

100 MHz from SB designs? Major firm offers such boards! SBs are excellent for many final and permanent circuits, and for many RF, Hi-V and Hi-I circuits! And much safer to health and environment. Comprehensive. Dozens of tips! \$29.

HACKING THE INTERNET

The latest tricks and methods being used on the Net to pirate software (warez) and the newest hacking websites. *Updated every two months.* Includes examples, countermeasures, password defeats, UNIX, Sprintnet, brute force methods, lots of tips, and more! \$29.

COMPUTER PHREAKING

Describes in detail how computers penetrate each other, and how VIRUSES, TROJAN HORSES, WORMS are implemented. Dozens of computer crime and abuse methods and countermeasures. Includes disk filled with hacker text files and utilities, and the legendary FLUSHOT+ protection system. Internet advice, password defeats, glossary - much more! Manual + PC Disk! \$39.

MANY MORE TITLES!

Hacking Fax Machines - \$29
PBX Hacking - \$19
Voice Mail Hacking - \$29
Beyond Phone Color Boxes - \$29
Hacking Answer. Machines - \$19
The Hacker Files - \$39
Internet Cons & Scams - \$19
Internet Tracking & Tracing - \$29
Hacking the Internet - \$25
Cookie Terminator - \$19
Beyond Van Eck Phreaking - \$29
Casino Hacking - \$25
Credit Card Scams - \$29
Social Engineering - \$29
Cons & Scams - \$29
Polygraph Defeats - \$25
By an Order of the Magnitude - \$49
Ultimate Success Manual - \$19
Stealth Technology - \$19
Secret & Survival Radio - \$19
Secret & Alternate IDs - \$15
Rocket's Red Glare - \$29
High Voltage Devices - \$29
Mind Control - \$29
Under Attack! - \$29
Radionics Manual - \$29
Heal Thyself - \$19

SPECIAL PROJECTS

We will design & build just about anything! Ask for our free SP Application Form! Hardware now done as SPECIAL PROJECTS only

THE DIRTY-2 DOZEN!

24+ Disks. See CATALOG!

STOPPING POWER METERS

As reported on "60 MINUTES"!

All-new 6th Edition! Over 45 pages jam-packed with how devices can slow down (even stop) watt-hour meters - while loads draw full power! Device plugs into one outlet and normal loads into other outlets. Describes meter creep, overload droop, etc. Plans only! \$29.

THE I.G. MANUAL: External magnetic ways (applied to meter) to slow down and stop power meters while drawing full loads. Plans \$25.

KW-HR METERS: How watt-hour meters work, calibration, error modes (many), ANSI Standards, etc. Demand and Polyphase Meters. Experimental results to slow and stop meters by others. \$25.

All 3 (above), Only \$59! (Add \$20 for SPM Video)

ORDER TODAY!

\$29

SPM THE VIDEO!

Now its easier to learn about KW-HR Power Meters than ever before! This educational video shows you how they work and their anatomy. Demonstrates SPMEM device and external magnetic methods used to slow and stop meters! Hosted by a top expert in the field. From the novice to the pro, an excellent source of info on these exciting devices! Great in combo with our SPM related manuals!

Only \$49 for SPM video + SPM manual!!

TOP SECRET

CONSUMERTRONICS

2430 Juan Tabo, NE, #259, ABQ, NM 87112

P.O. Box 23097 ABQ, NM 87192

505-237-2073 (9-5, M-F) NOTE: Take \$2.00 OFF all New Orders over \$20 placed by Mail or Fax

Full online Catalog: www.tsc-global.com/consumer.html

Fax: 505-292-4078 (all hours, orders only) Web Adventure: www.tsc-global.com

Established in 1971. Featured on CBS "60 Minutes," Forbes, New York Times. Add \$5 total S/H (US, Canada).

Sold for educational purposes only. Postal M.O. is fastest. VISA, MC OK. COD add \$7.

See Catalog for LIMITED WARRANTY, SPECIAL PROJECTS and all other Policies

10% Off
Orders Over
\$100!!



CIRCLE 226 ON FREE INFORMATION CARD

❖ ATTENTION CABLE VIEWERS ❖

CABLE VIEWERS. . .get back to your BASIC Cable Needs

Call 800-577-8775

For information regarding all of your BASIC cable needs.

5 GOOD REASONS TO BUY OUR FAR SUPERIOR PRODUCT

- ❖ PRICE
- ❖ EFFICIENT SALES AND SERVICE
- ❖ WE SPECIALIZE IN 5, 10 LOT PRICING
- ❖ ALL FUNCTIONS (COMPATIBLE WITH ALL MAJOR BRANDS)
- ❖ ANY SIZE ORDER FILLED WITH SAME DAY SHIPPING

We handle NEW equipment ONLY - Don't trust last year's OBSOLETE and UNSOLD stock!
COMPETITIVE PRICING—DEALERS WELCOME

HOURS: Monday-Saturday 9-5 C.S.T.

It is not the intent of B.E.S.W. to defraud any pay television operator and we will not assist any company or individual in doing the same.
*Refer to sales personnel for specifications.

**BASIC
ELECTRICAL
SUPPLY &
WAREHOUSING
CORPORATION**

P.O. Box 8180 ■ Bartlett, IL 60103 ■ 800-577-8775

CIRCLE 313 ON FREE INFORMATION CARD

ONLY COOL-AMP SILVERPLATES ON THE JOB.

From a customer testimonial:

"Ok, your edge connectors don't connect. Or you want to plate your own PC creations, but you don't want to bother with electro-plate solutions. The plating on the socket...has worn off and no longer makes reliable contact...what are you going to do now?

"Give the people at Cool-Amp a call. They have a silver plating compound I have used for the past couple of years that solves all of the above problems and more. This white powder has an infinite shelf life...and is easy to use.

"It will actually put a permanent silver plate on copper, brass or bronze...There are no messy or dangerous chemicals. Application could not be easier. Use a clean rag and a little bit of water and just rub it on a clean surface. In minutes you can permanently silver plate a circuit board or replating a power amp tube or socket.

"It has saved me time, money and my sanity."

Cool amp has even outperformed electroplating in recent tests. It is time-proven since 1944.

COOL-AMP

AND CONDUCTO-LUBE. THE SILVER-BASED CONDUCTIVE LUBRICANT.

The upstart, since 1952. Developed for switches, uses continue to expand to all applications needing a conductive lubricant.

Conducto-Lube

**ORDER FACTORY DIRECT:
503-624-6426 or FAX 503-624-6436**

<http://www.thomasregister.com/cool-amp>

CIRCLE 228 ON FREE INFORMATION CARD

EARN MORE MONEY!

Be an FCC LICENSED ELECTRONIC TECHNICIAN!



No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial Radio-telephone License." This valuable license is your professional "ticket" to thousands of exciting jobs in Communications, Radio-TV, Microwave, Maritime, Radar, Avionics and more...even start your own business! You don't need a college degree to qualify, but you do need an FCC License.

No Need to Quit Your Job or Go To School
This proven course is easy, fast and low cost! **GUARANTEED PASS**—You get your FCC License or money refunded. **Send for FREE facts now. MAIL COUPON TODAY!**

Or, Call 1-800-932-4268 Ext. 210

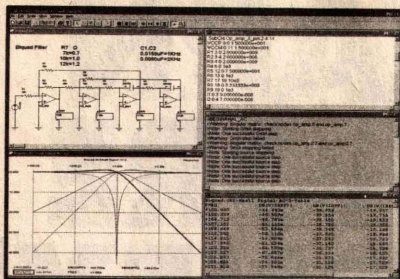
COMMAND PRODUCTIONS
FCC LICENSE TRAINING, Dept. 210
P.O. Box 2824, San Francisco, CA 94126
Please rush FREE details immediately!

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

September 1998, Electronics Now

81

CIRCUIT DESIGN FOR WINDOWS AND MACINTOSH



B² SPICE

B² SPICE and B² LOGIC are the best values in circuit simulation tools. They are used at over 100 major universities and many leading Fortune 500 companies including the University of Michigan, Stanford, AT&T, General Electric, and Motorola.

B² Logic provides precise and customizable timing of individual pins on each device. No other program in this price range will help you catch as many timing glitches and violations. It also supports busses and subcircuits to facilitate the design of complex circuits.

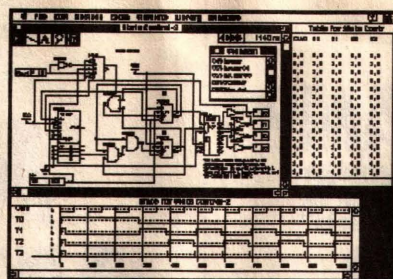
B² Spice integrates an intuitive interface with an optimized Spice engine. With a library of over 3000 parts, you will be able to find the part you need. In case you don't find it, you can easily import new parts into the libraries. The interface supports the full set of Spice3F5 simulations as well as Temperature and Parameter sweeps.



Beige Bag Software
279 E. Liberty
Ann Arbor • Michigan • 48104

Phone 734.332.0487
Fax 734.332.0392
E-Mail info@beigebag.com
Internet www.beigebag.com

CIRCLE 337 ON FREE INFORMATION CARD



B² LOGIC

B² SPICE \$249

- Simulations: DC, Parameter, Dual, and Frequency Sweeps, Transient, Noise, Fourier, Transfer Functions, Pole-Zero, Distortion
- Spice 3F5 (32-bit)
- Over 3000 devices
- Over 30 parameterized devices
- Powerful graph interface
- Device and model parameter dialogs
- Run simulations directly from netlists

B² LOGIC \$179

- Subcircuits and subcircuit probing
- Precise customizable pin timing
- Over 100 components available
- Define new devices with equations and tables including state variables

ELECTRONIC DESIGN PACKAGE \$279

- Includes B² SPICE and B² LOGIC
- Demo Disks Available
- University & Student Prices Available
- Site Licenses Available
- Dealer Inquiries Welcome
- Visa/MasterCard Accepted

WIRELESS VIDEO CAMERAS

Compatible with
AC or Battery



GFT-1001 \$189.95
Gives any camera the
ability to be Wireless.
Transmits Over 1000 ft.

Wireless 4-Channel B/W &
COLOR Cameras Available!
Plug and Play Readiness



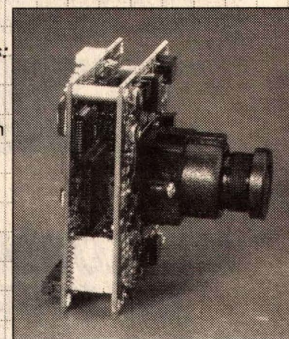
Wireless Observations System's
GFS-1001 (900MHz) - \$499.95
GFS-1001c (900MHz) - \$599.95
(1.2 Ghz system's available)

COLOR BOARD CAMERAS

Micro Color MB-960c Key Features:

- Lens: 3.6mm F=2
- Full Digital Process of BLC
- Auto Tracing White Balance
- 2H Mode of H.V. Aperture correction
- Digital process of color matrix
- Electronic Shutter up to 1/10,000
- *Dip Switch Adjustment settings:
6-BLC
5-Auto Shutter
4-AGC/On
3-Flickless
2-AWB/On
1-No function

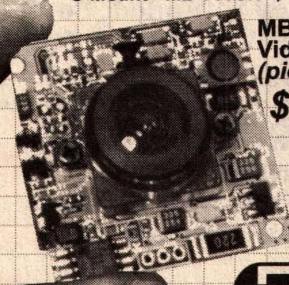
**MB-960c
\$199.95**



Size: 1.7 x 1.7 sq. x 2 PC Board

MB-750 SERIES BOARD CAMERAS

Pinhole • MB-750p - \$89.95
C-Mount • MB-750UX - \$119.95

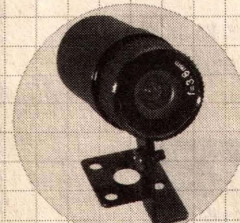


**MB-750U
Video Camera
(pictured)
\$99.95**



ODH-106

**ODH-106
Board Camera Housing**
4.5 x 2.75 x 2.75", High-Impact,
Weatherproof, w/ 5.5" Arm.



**LP-8501 Lipstick Camera
\$129.95**

Polaris Industries
<http://www.polarisusa.com>
800.752.3571

**FREE
Polaris Product Catalogs**

NIGHT VISION



Other Models
Available to
Choose From!

Night Vision Scope w/ Illuminator
Fun to use, Low cost.
3.6 x 85mm f1.6
MI-PR100 - \$399.95

470 Armour Drive NE • Atlanta GA 30324 • Tech Info: 404-872-0722 • FAX 404-872-1038

CIRCLE 217 ON FREE INFORMATION CARD

ALL ELECTRONICS

C O R P O R A T I O N

Great Sounding! KOSS DIGITAL Stereo Headphones

Koss MAC-5

Made for the Ford Motor Company for use in Windstar and Aerostar Vans. These

lightweight, adjustable headsets have great sound

quality with great bass response for home or studio use. Supra-Aural foam ear cushions for hear-through sound and comfort. The 8' rubberized cords are terminated with 3.5 mm stereo phone plugs. Frequency response: 20,000 HZ.

\$12⁵⁰
each

CAT #HP-5

10 for \$100.00

SPECIAL LOW PRICING Automotive Multi-Voltage Adaptor

Sanbor M-24

Regulated DC converter plugs into car cigarette lighter and provides power for portable audio and communications devices and many battery operated devices that operate on 500 ma or less. Voltage selector switch for 1.5, 3, 4.5, 6, 7.5 and 9 volts. Polarity switch. Six varieties of output plug including, 2.1, 2.5 and 1.3 mm co-ax power plugs, 2.5 and 3.5 mm phone plugs and 9 volt battery snap.

\$2⁰⁰
each

CAT #APC-522

10 for \$15.00

High Grade Stereo VIDEO/AUDIO DUBBING CABLE



75 ohm video cable with two audio cables for stereo dubbing. Heavy-duty gold plated metal RCA plugs with spring-steel strain reliefs. Black cord 5 foot long

CAT # AVS-60

\$5⁰⁰
each

Special Price! AA CELL Rechargeable Nickel-Cad

Our Lowest Price Ever!

1.2 volts 600 mAh

0.56" diameter

X 1.969" long

CAT # NCB-AA

\$1²⁵
each

10 for \$11.00 • 100 for \$100.00

UV Blacklight

New black-light lamps designed by Avon Cosmetics to highlight dry skin. They have a built-in timer that shuts-off the lamp after approximately one minute. We provide instructions on how to override this feature which requires soldering a jumper inside the lamp. The lamp circuit gets warm when run for extended periods of time. Ideal for lighting fluorescence in black-light posters, gemstones, hand stamps and US currency. 5" lamp, F4T5BLB, is housed in a lightweight plastic case. 7" x 3.25" x 2.3" high. Powered by a 12 Vdc, 500 ma wall transformer (included). Individually boxed.



CAT# UVL-1

\$10⁰⁰
each

5" Black Light Tube

F4T5-BLB. Replacement lamp for fixture above.

CAT # BLB-5

\$3⁰⁰
each

QUALITY
PARTS

FAST
SHIPPING

DISCOUNT
PRICING

CALL, WRITE, FAX
or E-MAIL For A
Free 96 Page
CATALOG.
Outside the U.S.A.
send \$3.00 postage.

RED Ultrabright LED

PAINFULLY BRIGHT RED LED

2500 to 4000 mcd @ 20 ma. These T 1 3/4 (5 mm diameter) red LEDs are significantly brighter than conventional LEDs. At close range, they are painful to look at. They are great for attention getting displays that can be seen from a distance. Water clear in off-state.

CAT # LED-42

2 for \$1²⁰

10 for \$5.00
100 for \$45.00
1000 for \$400.00



Key Switch / Drawer Lock Set

High-quality key

switch and drawer

lock set manufac-

tured for Hewlett

Packard. Both are

keyed alike. Both

switch and lock

have 0.87" diam-

eter, brushed alu-

minum tapered

bezel. Both have

threaded bushings

that fit 0.75" diam-

eter holes. S.P.S.T.

switch. Key can be

removed in both positions. The key switch will

fit up to 0.9" thick panels and comes with a 0.5"

high collar that can be used to raise it above

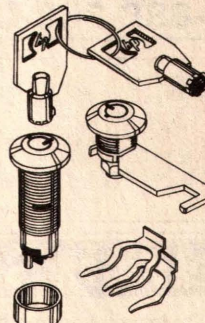
the panel. The drawer lock fits panels up to

0.3" thick. Includes 2 keys

and mounting clips.

CAT # KSW-19

\$5⁰⁰
set



"HI-8" Video Cassette

SONY Hi-8 Top quality, metal particle 120 minute video cassettes. Used for a short time, then bulk-erased. Each cassette has its own plastic storage box.



CAT # VCU-8

\$3⁰⁰
each

10 for \$28.00 • 100 for \$250.00

ORDER TOLL FREE

1-800-826-5432

MAIL ORDERS TO:
ALL ELECTRONICS CORP.
P.O. BOX 567
VAN NUYS, CA 91408-0567

FAX (818) 781-2653 • INFO (818) 904-0524
INTERNET <http://www.allcorp.com/>
E-MAIL allcorp@allcorp.com

NO MINIMUM ORDER • All Orders Can Be Charged to Visa, Mastercard, American Express or Discover • Checks and Money Orders Accepted by Mail • Orders Delivered in the State of California must include California State Sales Tax • NO C.O.D. • Shipping and Handling \$5.00 for the 48 Continental United States - ALL OTHERS including Alaska, Hawaii, P.R. and Canada Must Pay Full Shipping • Quantities Limited • Prices Subject to change without notice.

MANUFACTURERS - We Purchase EXCESS INVENTORIES... Call, Write, E-MAIL or Fax YOUR LIST.

CABLE TV EQUIPMENT

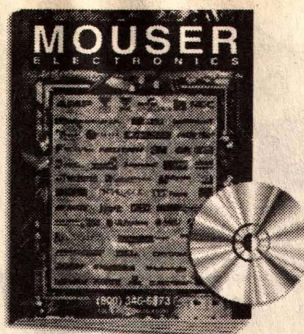
Converters, Test Cubes & Chips

**1 Year Warranty
30 Day Money
Back Guarantee**



**"ABSOLUTE LOWEST
WHOLESALE &
RETAIL PRICES"
CABLE U.S.A.
1-888-388-CUBE**

ELECTRONIC COMPONENTS



Visit our web site!
www.mouser.com

FREE catalog is available,
on the internet, CD-ROM,
or in paper!

- Over 70,000 Products
- More than 145 Suppliers
- Same Day Shipping
- No Minimum Order

800-992-9943

817-483-6828 Fax: 817-483-0931
catalog@mouser.com

958 North Main St., Mansfield, TX 76063

CIRCLE 318 ON FREE INFORMATION CARD

BEST DEALER PRICING!

CABLE DIRECT

CONVERTERS • FILTERS
DESCRAMBLERS

IMPROVE YOUR IMAGE WITH
VIDEO STABILIZERS

**FREE
CABLE TV
CATALOG!**

**100%
MONEY BACK
GUARANTEE!**



**30 DAY
FREE
TRIAL!**

Now you can tune-in your favorite
cable TV programming
and **SAVE \$100'S -
EVEN \$1000'S** on premium
CABLE TV EQUIPMENT.



**MODERN
ELECTRONICS
1-800-906-6664**

2609 S. 156TH CIRCLE • OMAHA, NE 68130
<http://www.modernelectronics.com>

Network Service Tool Set

Popular installation and service tools for networks, modems and
telephones. All hand tools are professional heavy duty type.

Use the compact tester on 10BASE-T (UTP & STP), thin
Ethernet (BNC), 8-position Token Ring, AT&T 258A and
EIA/TIA 568A/B. Automatically scans cables for continuity,
wiring sequence and polarization. Tests STP cable ground.
Testing installed cables is easy with Remote Terminator
and gender changers (UTP and BNC). 9V battery included.

- Coax Stripping Tool, RG-58 & RG-59
- BNC Crimping Tool, RG-58 & RG-59
- Modular Cutting/Stripping/Crimping
Tool (4, 6 & 8-Position)
- Multi-Network Cable Tester
- AC Receptacle Tester
- Cable Cutter

Order No. 55625 \$197.00



PC Service Tool Set

Contains all tools needed to troubleshoot & service
IBM-compatible PCs. Set includes:

- AMI Diagnostic Software
- POST Card
- Logic Probe
- Digital Multi-Meter
- AC Receptacle Tester
- Serial Adapter
- Serial & Parallel
Loopback Connectors
- DIP IC Puller
- PLCC IC Puller
- Grounding Wrist Strap
- Key Top Puller

PC Diagnostic Tool Set

- AMI Diagnostic Software
- POST Card

Order No. 55555 \$89.00

Network Installation Tool Set

- Network Tool Set 55625
without the Multi-Network
Cable Tester.

Order No. 55600 \$99.00

Call for your **FREE Catalog**
Graymark®

P.O. Box 2015 Tustin, CA 92781
<http://www.labvolt.com>

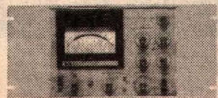
Order No. 55000 \$198.00



**CALL TODAY!
800-854-7393**



AUDIO WAVE ANALYZER



HEWLETT-PACKARD 3581A WAVE ANALYZER, separates and measures frequency and amplitude spectral components over 15 Hz to 50 KHz

with 1 Hz resolution. Uses 5-digit LED freq- readout & analog meter for amplitude analysis. Meter scales: Volts (30 V - 100 nV linear), 90 dB or 10 dB display (+30 dB to -150 dB log). Sweep scan width adjustable 50 Hz to 50 KHz. Requires 100-120/200-240 VAC 48-440 Hz. Option 003 rack-mount: 10.5x19.3x16.3, 30 lbs. USED-CHECKED, \$595.00

TEKTRONIX 465M SCOPE

AN/ USM-425 militarized DC-100 MHz dual-trace oscilloscope with 8x10 CM display. Deflection 5 mv to 5 V/div in 10 calibrated steps, 1-2-5 sequence + vernier. Vertical modes: TRIG View, 20 MHz BW, CH 1, ALT, Add, Chop, CH 2 or X-Y. Sweep 0.05 usec to 0.5 sec/div in 22 steps + vernier; delay 0.05 usec to 50 msec/ div. Also X10 magnifier, adjustable handle, front cover and manual copy. Requires 100-132/200-264 V 48-440 Hz; 7x1.7x21.5, 32 lbs sh. USED-CHECKED, \$475.00



AIRCRAFT SEXTANT



w/ PERISCOPE, used in older military aircraft to determine nightflight position. Cupped eyepiece views through right angle periscope with bubble level. Controls vary bubble size, adjust lens diffuser plus filters red, green & polarized. Also mechanical timer, 3-digit 100-turn counter dial & fiberglass case. Nice experimenter's item! Requires 28 V AC-DC for lights; 8"W x13"H x5.3"D, 23 lbs sh. #MS28011-1F, used, \$75 \$59.50

Prices F.O.B. Lima, Ohio. VISA, MASTERCARD accepted.

Allow for shipping charges. Write for latest Catalog.

Address Dept. ES + Phone 419/227-6573 + FAX 419/227-1313

E-mail: fairradio@wcoil.com Home: http://alpha.wcoil.com/~fairradio

FAIR RADIO SALES CO.

1016 E. Eureka + Box 1105 + Lima, Ohio 45802

LASERS

AT GREAT PRICES

Complete Ruby Laser Assembly less than \$300

He-Ne Lasers, complete, for less than \$50

American 60X Argon Lasers from \$595

Laser Diode Modules from under \$40

X-Y Scanners from \$79

FREE CATALOG

- Helium-Neon
- Argon Lasers
- Diode Lasers
- Holography
- Books
- Ruby Lasers
- Scanners
- Lightshow Equipment
- Pointers
- Optics

Email: mlp@nlenx.com http://www.midwest-laser.com



Midwest Laser Products

P.O. Box 262, Frankfort, IL 60423

Phone: (815) 464-0085 FAX: (815) 464-0767

30 Day Satisfaction Guarantee.

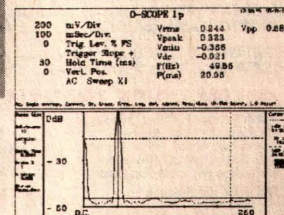
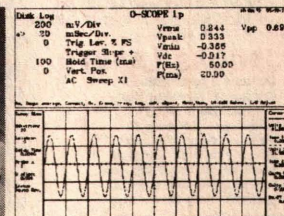
VISA / MC Accepted

DIGITAL STORAGE OSCILLOSCOPES

WITH
SPECTRUM
ANALYZER,
DVM, FREQ.
COUNTER,
AND DATA
LOGGER.

from
\$189.

PORTABLE
MODULES
CONVERT PC'S
INTO
MULTIPURPOSE
TEST AND
MEASURING
INSTRUMENTS.



Why lug a scope around? Toss one of our modules into your laptop case or tool kit. For a multi-purpose test device, plug to a PC parallel port and use the PC screen. Continuous, delayed, or triggered sweeps can be frozen on the screen, printed out, or saved to disk. Frequency Spectrums DC to 25 MHz.

Allison now provides PICO TECHNOLOGY Ltd. portable test equipment, including high-speed scopes, and multi channel data loggers. Pico and O-Scope modules accept standard probes and work with 286 or faster PC's.

FEATURES:

- ♦ PORTABLE UNITS TO 25 MHz
- ♦ USES PRINTER PORT
- ♦ USES STD. PROBES

OPTIONS:

- ♦ PROBE SETS
- ♦ AUTOMOTIVE PROBES
- ♦ BATTERY PACKS
- ♦ SOFT & HARD CASES

O-Scopes Made in U.S.A.

Picos Made in U.K.

Same Day Shipping

Includes Cable, Software & Manuals

O-Scope I (DC-50KHz, single trace)\$189.

O-Scope II (DC-500KHz, dual trace)\$349.

PICO (ADC 200/20) (DC-10MHz, dual trace) CALL

PICO (ADC 200/50) (DC-25MHz, dual trace) CALL

PICO pc based data loggers from \$99.

Shipping within U.S. UPS Ground \$7.50(Second day \$11.50)

SEND CREDIT CARD INFO., M.O., or CHECK, OR CALL

1-800-980-9806

Allison Technology Corporation

8343 CARVEL, HOUSTON, TX. 77036 U.S.A.

PHONE: 713-777-0401 FAX: 713-777-4746 BBS: 713-777-4753

http://www.atcweb.com

AMAZING PRODUCTS! INFORMATION

UNLIMITED DEPT EN 0498
BOX 716 AMHERST, N.H. 03031

VISIT OUR 'ACTION' WEB SITE!
<http://www.amazing1.com>

ATTENTION!! RAILGUN EXPERIMENTERS HIGH ENERGY PULSER

RAIL GUN, COIL GUN, EXPLODING WATER, ANTIGRAVITY, MASS
WARPING, LEVITATION, PLASMA PROPULSION, LATTICE SNAPPING, EMP etc

- Lossless Energy Charging
- Programmable Voltage to 2 KV and Energy Control to 3 KJ
- Triggered Spark Switch (IKJ)
- Universal 12 VDC or 115 VAC
- 7.5 X 7.5 X 7" Light weight



HOTSHOT

HEP3 Plans High Energy Pulser/Ignitor.....\$15.00
HEP3K Kit/ Plans (With 500 Joules Energy Storage).....\$49.50
HEP30 Assembled (With 500 Joules Energy Storage).....\$449.50
All Individual Parts and Subassemblies Available

BURNING LASER RAY GUN

BLASTS THRU THE HARDEST OF METALS!



All Parts Available

A FUTURISTIC CONCEPT!!

LAGUN2 Plans.....\$20.00

BURNING CO2 BENCH LASER

HOTTER THAN MOST TORCHES!



All Parts Available

LC7 Plans.....\$20.00

ELECTRONIC HYPNOSIS AND MIND CONTROL

Generates Highly Effective Audible and Visual Stimuli With Bio-Feedback That Can Induce Hypnotic as Well as ALPHA Relaxed States of the Mind. Place Subjects "Under" Your Control. Enhances Hidden PSYCHIC Ability in Many People!



MIND Plans.....\$15.00
MIND2K Kit and Plans.....\$49.50
MIND20 Assembled.....\$89.50

JACOBS LADDER

Observe a pyrotechnical display of "traveling" fiery plasma. Starts off as 1/2" arc and expands to over 3" before evaporating into space. This is an excellent attention getting display as well as a winning science project!! With arc control.



JACK1 Plans.....\$8.00
JACK1K Kit Minus Case.....\$129.50
JACK10 Ready to Use.....\$249.50

12KVGEN20 Pwr Supply Only.....\$99.50
12KVGEN2K Kit of Pwr Supply.....\$79.50

3Mi FM VOICE TRANSMITTER

Safety Product Allows Listening to Children or Invalids in Hazardous Areas, Pools, Ponds etc. Great Security Intrusion Alert! Uses FM Table Top Radio.



FMV1K Kit/Plans.....\$39.50

ATTENTION! ANTI GRAVITY,

We Can Supply Low Cost HIGH VOLTAGE Current Producing Generators from 50 to 500 KV. Contact Factory For Details or Call 603 673 6493

MICRO MINI MITE

TESLA COIL

LIGHTS UP A 4 FT FLOURESCENT TUBE WITHOUT CONTACT!! YET ONLY 3" TALL! Super Magic Trick Low Cost Science Project 12 VDC/115 VAC Operation



MTC1K Kit/Plans.....\$19.50
MTC10 Ready to Use.....\$34.50

PHASOR BLAST WAVE PISTOL

130 db of Directional Sonic Shock Waves Energy Handheld and Battery Operated



PPPI Plans.....\$8.00
PPPIK Kit/Plans.....\$49.50
PPP10 Ready to Use.....\$79.50

HOVERBOARD PLANS

Kit Soon to be Available

28 Pages of "how to" build a magnetic force field capable of containing a column of ionized air up to several psi! Proven theory may require additional experiment



HOVER Plans.....\$25.00

TELEPHONE TAPING SYSTEM

EXTENDED X4 PLAY, Tapes Phone Conversation 20 Mega Input Z1 Check Laws!



TAP30X Ready to Use.....\$84.50
BEEP10 Beeper Alert.....\$29.95

TRANSISTORIZED TESLA COIL

URNS A LIGHT BULB INTO A SPECTACULAR PLASMA DISPLAY

Transmits Wireless Energy Noiseless Operation Pyrotechnic Effect 12 VDC/5 Amps or Battery 115 VAC Optional Converter Adjustable Frequency Control For Effect



TCL5 Plans.....\$8.00
TCL5K Kit/Plans.....\$59.50
TCL50 Ready to Use.....\$109.50
12DC/7 12VDC@7Amps.....\$39.50

1 800 221 1705 ORDERS ONLY! FAX 1 603 672 5406 INFO 9-5pm 1 603 673 4730 FREE CATALOG ON REQUEST

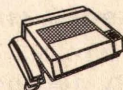
Pay by MC, VISA, Cash, Chk, MO, COD. Please Add \$5.00 S&H plus \$5.00 if COD. Overseas Please Contact for PROFORMA



Free Catalog

If you are not getting this catalog you are missing out on some of the best deals in electronics today! We have thousands of items ranging from unique, hard-to-find parts to standard production components. Call, write, or fax today to start your free subscription to the most unique catalog in the industry, filled with super values on surplus electronic and hobbyist type items. If you have a friend who would like to receive our catalog, send us their name and address and we will gladly forward them a complementary 100 page catalog.

Why pay more? Call today.



340 East First Street Fax Order Line
Dayton, Ohio 45402 1-800-344-6324

Order Toll-Free
1-800-344-4465

CIRCLE 251 ON FREE INFORMATION CARD

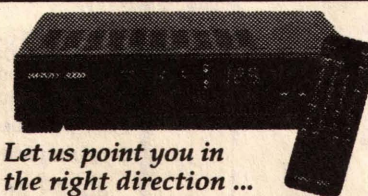
Call Today And **SAVE!** Unbeatable **PRICES!**

CABLE TV

DESCRAMBLERS
CONVERTERS · FILTERS
VIDEO STABILIZERS

FREE > 30 Day Trial
FREE > Product Catalog
FREE > 1 Year Warranty

100% MONEY BACK GUARANTEE



Let us point you in the right direction ...

Arrow
Technologies
Omaha, Nebraska

TOLL FREE
888-554-ARROW
888-554-2776

POPTRONIX®

Online Edition

We're on the web

FREE

We are starting up, but you can watch us grow!

Projects for beginners to experts!

New Product information!

Bookstore—discover what's new!

<http://www.poptronix.com>

WE'RE WITH YOU EVERY DAY
24 HOURS A DAY! DROP IN!
WE'D LOVE TO HAVE YOU VISIT!

MY PERSONAL GUARANTEE with the New & Improved More Vacuum **DEN-ON SC7000Z**

Lane Norman - Norman's Electronics Inc. Atlanta GA 404-451-5057

A cost effective solution to desoldering equipment at less than half the price of most equipment. It's performance is ASTOUNDING.

Mike Murphy - Service Center - Van Nuys
CA 818-785-7805

The single best investment of repair equipment we've made. It outperforms all other desoldering tools we've used. Easier to use and least expensive.

Quicker Vacuum

George McKinzie - MCK Electronics, Inc. - Nisswa MN - 218-963-4400
A marvelous instrument, a real time saver and has a tremendous vacuum for it's size. The size and portability is also a great advantage.

Dick Manning - Dicks Electronics - Hartland WI 414-367-8339
The ease & speed of component removal greatly increases productive time. The SMD kit makes SMD removal a breeze, even for inexperienced Techs.

George Hefner - Hefner Electronics - Coleridge NE 402-283-4333
Being a one-men service center, I hesitated to spend the money on a desoldering tool, however all that changed when I nearly ruined a \$400 computer logic board. It has cut my desoldering time by 50%

Service Managers, Owners, CEO's, CFO's

My personal guarantee to you is that after 90 days of ownership, if you are not convinced that you have made a wise decision for your business with the purchase of the SC-7000Z desoldering tools, your investment will be fully refunded with the return of the merchandise. Now you have no reason not to try it.

Jerry Howard, President.

- ◆ Totally Self Contained diaphragm vacuum pump and AC motor for high vacuum suction or reversible hot air blow for SMD removal.
- ◆ 100Watt Ceramic heater with zero-crossover switching heater control circuit which prevents spikes and leakage currents.
- ◆ Unique patented long lasting filter cartridge design. Solder builds up on easily cleaned baffle, while air flows around the outside of baffle.
- ◆ Totally ESD Safe. The housing contains carbon and the tip is at



FREE TRIAL

Available on Request

**Sale Price
\$395.00**

Price includes
stand worth \$25.00
one extra filter, and
two tip cleaners.

Don Cressin - Certified Electronics
Service - Ellicott City MD 301-461-8008

We have obtained excellent results with the SC7000Z including repairing high density U/V tuners. It is one of the best purchases we have made.

Doug Pettit - LuRay
Electronics - LuRay VA 703-743-5400

We found that the SC7000Z not only saves money vs. wick, but saves valuable time in troubleshooting. It allows you to be more accurate in removing SMD's.

Randy Whitehead - Service West - Salt Lake City UT 801-262-4069
My Techs thought it would be a waste. I bought one anyway after a demo. My Techs then fought over it. Now we have three. It is the Best desoldering tool we have ever used.

**Check us out on the WEB
<http://www.heinc.com>
Order from web site for 5% discount**

New Specifications

- ◆ Voltage—AC100V, 120V, 230V, 50/60Hz
- ◆ Power Consumption—120W
- ◆ Pump—Diaphragm Type
- ◆ Motor Output—12W
- ◆ Vacuum Attained—650mmHg
- ◆ Temperature Range—300°C—500°C (572°F—932°F)
- ◆ Air Flow Rate—15 Liter/Minute (Open)
- ◆ Heater—100W (Ceramic)
- ◆ Control System—Feed Back Zero Cross-over Type
- ◆ Net Weight—420Grams
- ◆ Max.Temp. of Hot Blow—400°C
- ◆ The Most Cost Effective Desoldering Tool in the World.

**Visa - M/C - Discover - American Express - Terms to Qualifying Companys
30 Day Money Back Total Satisfaction Guarantee - One Year Parts and Labor Warranty**

HEIN ELECTRONIC
INSTRUMENTS INC
Your Desoldering Specialists

Toll Free U.S. and Canada
1-800-394-1984

Web Site www.heinc.com
E-Mail sales@heinc.com
International (316) 744-1993
or Fax (316) 744-1994

SURVEILLANCE

The Latest High Tech Professional Electronic Devices

Our latest catalog offers a HUGE selection of surveillance, counter-surveillance/privacy devices: **pinhole camera \$129⁰⁰**, hidden video, "realtime" 12-Hour telephone recorder \$139⁰⁰, 12 hour VOX recorder phone call register, scanners, bug/phone tap detectors, voice disguisers, locksmithing tools, vehicle tracking, wireless video, and much more. Wholesale/retail.

We will not be undersold.

Catalog \$5.00 or

www.spyoutlet.com

SPY OUTLET

PO Box 337, Buffalo NY 14226
(716) 691-3476/(716) 695-8660

VIDEO SYNC GENERATOR



Restores Horizontal and Vertical Sync Lines from Distorted Video



Lost Sync

For Free Information Package and Pricing



Call 219-236-5776

www.south-bend.net/rcd

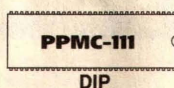
R.C. Distributing, P.O. Box 552, South Bend, IN 46624



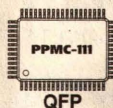
Restored Sync with VSG

Intelligent Stepper Motor Control

67,000 pps... Trapezoidal or Parabolic Acceleration
"On-the-Fly" Speed Change... Lots of other stuff too



OR



\$29.50 (100's)

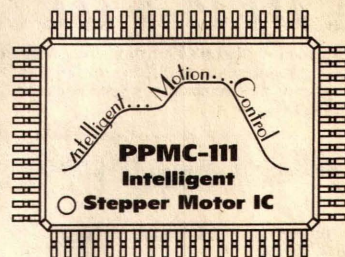
PC compatible DEMO BOARD available



Sil Walker

880 Calle Plano, Unit N, Camarillo, CA 93012

(805)389-8110 voice... (805)484-3311 fax... Email: silwkr@vcnet.com



Filter Wiz v2.0

ACTIVE FILTER design software for Windows. Provides mastery of lowpass, highpass, bandpass and bandstop filters. Enhance critical signal components while controlling noise and other interference.

Meets the needs of both novice and professional designer. Standard (LE) version \$89, PRO version \$199.

Download: <http://www.schematica.com>

sales@schematica.com FAX: 250-642-2644

3 Axis Motion Control System

Complete, ready to run

\$255.50 + 12.00 S/H

Build or adapt CNC mills, CNC routers, Robots, Etc. Includes: 3 Stepping motors (70 oz/in 200 steps/rev). External board (connects to parallel port of a PC). Power supply. Cables, Manual and the MAXNC drive software, with linear, circular and helical interpolation, acceleration deceleration, full contouring, 'G' code programming, screen plot, code generation from CAD (CAM), and more.

For more information, phone or write to:

MAXNC

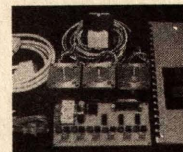
6730 West Chicago

Suites 2 & 3

Chandler, AZ 85226

Ph (602) 940-9414

Fax (602) 940-2384



ALFA ELECTRONICS

HIGH QUALITY TEST EQUIPMENT

Visit www.alfaelectronics.com for complete info

Call 1-800-526-2532 for Order and Free Catalog

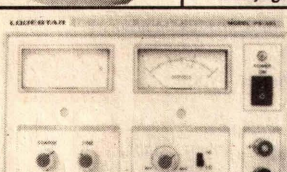


DMM
DMM-898 (\$179.00): true rms, AC/DC (V, A), Ω , bar graph, freq, capac., dBm, logic, diode
DMM-23T (\$99.95): 4 1/2 digit, true rms, high resol. (10 μ V, 10nA, 10m Ω), hFE, diode, contin.
DMM-20 (\$74.95): AC/DC (V, A), Freq, cont., Capac, Induct., Ω , hFE, diode, duty cycle
DMM-122 (\$59.95): DC/AC (V, A), Ω , hFE, diode, capacitance, freq, logic, continuity
DMM-123 (\$44.95): DMM + capacitance, DC/AC (V, A), Ω , hFE, diode, continuity
DMM-10 (\$19.95): 3 1/2 digit, DC/AC V, Ω , hFE, diode, signal output (+3V, -0.5Vsq., 50% duty)



TOP/COUNTER
CAP-15 (\$49.95): 3 1/2 digit, 0.1pF-20mF, 9 Ranges, 0.1pF resolution, zero adjustment.
LCR-24 (\$139.95): 0.1 μ H-200H, 0.1pF-2000 μ F, 0.01 Ω -20M Ω , diode test. New Model.
LCR-131D (\$219.95): autorange, 0.1 μ H-10kH, 0.1pF-10mF, 1m Ω -10M Ω , Q Factor, serial/parallel, 120Hz/1kHz testing mode.
FC-1200 (\$129.95): 1.25GHz Handheld, 8 digits display, 10ppm accuracy, sensitivity 5mV (130-350MHz), 30mV (440MHz)

FLUKE SPECIALS
12B \$84.95
70-III \$85.00
73-III \$115.00
75-III \$139.00
77-III \$154.00
79-III \$175.00
87-III \$309.00
92B-III \$1,445
96B-II \$1,695
99B-III \$2,095
105B \$2,495
123-III \$945
863E \$475
867B \$650
AC Current Probe \$34.95
DC/AC Current Probe \$79.95
Mini AC Clamp \$59.95
AC Clamp w/temp \$89.95
DC/AC Clamp \$109.95
Thermometer \$69.95-\$89.95
IR Thermometer \$189.95
Sound Level Meter \$169.95
Tachometer \$169.95-\$219.95
EMF Tester \$69.95
Pressure Meter \$299.95
Watt Meter \$129.95
High Voltage Probe \$59.95
pH Meter \$79.95
Light Meter \$80-\$90



Single Output DC Power Supplies
• Constant current, constant voltage mode
• Short Circuit and overload protected
Analog Meters Display
PS-303 (\$159.00) 30V/3A
PS-305 (\$219.95) 30V/5A
PS-8112 (\$399.95) 60V/5A
PS-1610 (\$289.00) 16V/10A
PS-8107 (\$399.95) 30V/10A
Digital Volt, Analog Current
PS-8200 (\$179.95) 30V/3A
PS-8201 (\$239.95) 30V/5A
Digital Volt & Current Display
PS-8300 (\$199.95) 30V/3A
PS-8301 (\$259.95) 30V/5A

Triple Output
• Independence or Tracking operation
• Parallel to double current output
• PS-8102 & PS-8103 only
Triple Output (Analog displays)
PS-8102 (\$399.95) 30V/3A/30V/3A
PS-8103 (\$489.95) 30V/5A/30V/5A
Digital Displays
PS-8202 (\$499.95) 30V/3A/30V/3A
PS-8203 (\$549.95) 30V/5A/30V/5A

AUDIO/RF/FUNCT. GEN.
RF Generator • SG-4160 (\$124.95) 100kHz-150MHz sinewaves in 8 ranges
• SG-4162AD (\$229.95) with 6 digit counter
Audio Generator • AG-2601 (\$124.95) 10Hz-1MHz, 0-8Vpp sine, 0-10Vpp squarewave
• AG-2603AD (\$229.95) with 6 digit counter
Function Generator • FG-2100A (\$169.95) 0.2Hz-2MHz, 5mV-20Vpp
• FG-2103 (\$329.95) Sweep 0.5Hz-5MHz

GW/INSTEK

20 MHz Scope Cursor Readout

Triple Output

Single Output

Programmable

FUNCTION GENERATOR

BENCHTOP DMM



• OS-620 \$324.95
• Most economical scope
• Dual CH/X-Y operation
• 1 mV/div sensitivity
• Z-axis input, CH1 output
• TV syn. ALT trigger
• 2 probes (x1, x10)



• OS-626G \$599.95
• Readout & Cursor means
• Dual CH / Delay sweep
• Auto track, serial, parallel
• Const. volt, current mode
• 4 analog or 2 digital display
• ALT trigger, Hold-Off
• Z-axis input, CH1 output
• 2 probes (x1, x10)



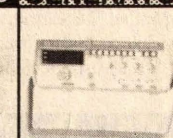
• 2 variable out 0-30V, 0-3A
• One fixed 5V, 3A output
• Auto track, serial, parallel
• Const. volt, current mode
• 4 analog or 2 digital display
PC-3030 (\$499.95)
PC-3030D (\$549.95) digital



• Const voltage, current mode
• Voltage regulation $\leq 0.01\%$
• Current regulation $\leq 0.2\%$
PS-1830 (\$209.95) 18V/3A
PS-1850 (\$229.95) 18V/5A
PS-1830D (\$229.95) 18V/3A
PS-1850D (\$254.95) 18V/5A



• Auto serial/parallel (PPT ser)
• Auto track (PPT series), IEEE-488.2 and SCPI compatible command set
PPT-1830G (\$1,149.95) 18V/6A
PPT-3615G (\$1,149.95) 36V/1.5A
PPT-1830G (\$1,499.95) 18V/3A
PPT-3615G (\$1,499.95) 36V/1.5A



FG-8020G (\$209.95)
• 0.02Hz-2MHz w/counter
• Sine/Sqr/Tri/pulse/Ramp
FG-8016G (\$229.95)
• 0.02Hz-2MHz w/counter
FG-8050 (\$499.95) Sweep
• 0.05Hz-5MHz w/counter
• INT/EXT AM/FM mod



DM-8034 (\$179.95) 3 1/2 dgt
• AC/DC (V, A), Ω , diode
DM-8040 (\$339.95) 3 1/2 dgt
• ACV to 50kHz, true rms
DM-9055G (\$889.95) 5 1/2 dgt
• 0.006% accuracy, GPIB
• dBm, auto, REL, min/max

ALFA ELECTRONICS

P.O. BOX 8089

PRINCETON, NJ 08543-8089

TEL: (800)526-2532 / (609) 897-1135

FAX: 609-897-0206

E-mail: alfa0168@aol.com

Call / Write / Fax / Email for FREE CATALOG

Visa, MC, AMEX, COD, PO Accepted. OEM Welcome.

1 Year Warranty (2 Years for GW/Instek)

CIRCLE 213 ON FREE INFORMATION CARD

"I earned \$1,000 on just 12 VCR repairs in one week"

A true statement by Paul B.* of San Pedro, California

How to cash in on skyrocketing field of VCR repair!

You too can earn up to \$85 an hour, pocket \$200 a day, double your income...in the high-profit field of VCR repair...part-time or full time. There are over 77 million VCR's currently in use in America today - a lot of business out there just waiting for you!

Here is a once-in-a-lifetime opportunity to go into a booming business of your own, make really big money starting right away, be your own boss and enjoy financial freedom and security.

It's easy to learn VCR cleaning, maintenance and repair at home in just a few short weeks through Foley-Belsaw's unique method which emphasizes the mechanics involved in 90% of all repairs, without dwelling on all the unnecessary basic electronics. This exclusive practical hands-on course was developed and proven over a long period of time in an actual VCR repair shop. It combines simple step-by-step lessons with easy-to-follow video cassette guidance. No special experience or electronics background is necessary. Just average mechanical aptitude and the ability to follow simple A-B-C repair procedures that are clearly outlined for you. And when you complete the course you will receive the School's official diploma attesting to your expertise.

Send coupon today for FREE Fact Kit. No obligation.

Don't miss out on this opportunity to give your income a tremendous boost. Send in the coupon NOW. Get all the facts and study them in the privacy of your own home. There's absolutely no obligation and no salesmen will call on you. So don't delay. Mail the coupon today!

"I started 3 months ago, now earn over \$900 a week."
D.K., New York, NY

"Took in over \$3,200 in the past 10 days!"
H.H., Denver, CO

"Doubled my income within 6 weeks."
R.B., Bakersfield, CA

*Last name withheld by request.



MAIL TODAY FOR FREE INFORMATION PACKAGE

**Foley-Belsaw Institute,
6301 Equitable Road
Kansas City, MO 64120-1395**



CHECK ONE BOX ONLY FOR FREE INFORMATION KIT!

☐ **YES**, without obligation send me information on how I can learn at home to become a VCR technician. 62832

- | | |
|--|--|
| ☐ Computer Repair 64734 | ☐ TV/Satellite Dish 31603 |
| ☐ Computer Programmer 35550 | ☐ Electrician 95411 |
| ☐ Networking Specialist 39361 | ☐ Computer Specialist 38374 |

Name

Address

City State Zip

PC
PLACE

September 1998, Electronics Now

89

386 MINI-PC \$83

1K PRICE
EVAL \$295
8088 \$27



includes:

- 5 Serial, 3 Parallel (32bit max)
- Up to 8 meg ROM (27C080)
- 32k RAM exp. to 64Mbyte
- Battery backed RT Clock
- LCD and Keyboard ports
- IRQ x15, DMA x2, TIMER x4
- On-board LED display
- Industry Standard PC Bus

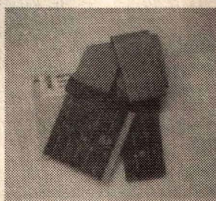
Perfect when a full-size PC is too large, expensive, or power hungry. A fully functional single board computer, needs only program and power source. Runs DOS / WINDOWS. Use Turbo C, BASIC, MASM. All utilities to do this included.

A to D D to A CONVERTERS

For PC or SBC
8,12,16 bit resolution
up to 24 channels
starting at \$21 OEM (1k)
eval kit \$75

\$95 UNIVERSAL PROGRAMMER

FLASH, EEPROM, NVRAM, EPROM
up to 8 meg (27C64-080). Adapters for
micros, PLCC, etc. Parallel port version
for notebook. FAST AND EASY TO USE.



LOW COST... LOW POWER...

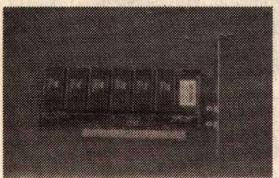
LOW RISC!

QTY 1K PRICE
\$1.99
EVAL KIT 7.00

LOWER COST, FASTER, EASIER TO PROGRAM SINGLE CHIP COMPUTER

COMPARE:	16C54	MV1200		PINOUT:
OEM (1K) PRICE	\$2.57	\$1.99		
RS232 PROGRAM DOWNLOAD	NO	YES	RESET	1 20 VCC
SINGLE CHIP OPERATION	NO	YES	PD0	2 19 PB7
BUILT-IN BASIC	NO	YES	PD1	3 18 PB6
EEPROM DATA MEMORY	NONE	64	XOUT	4 17 PB5
PROGRAM MEMORY	768 OTP	1K FLASH	XIN	5 16 PB4
MATH REGISTERS	1	32	PD2/INT	6 15 PB3
MAX INSTRUCTIONS / SEC	5M	20M	PD3	7 14 PB2
MAX COUNTER BITS	16	18	PD4/TMR	8 13 PB1/AD1
INPUT / OUTPUT BITS	12	15	PD5	9 12 PB0/AD0
A TO D COMPARATOR	NO	YES	GND	10 11 PD6
HARDWARE INTERRUPTS	NONE	3		

- LONG WORD INSTRUCTION - FRIENDLY SYMMETRIC ARCHITECTURE -



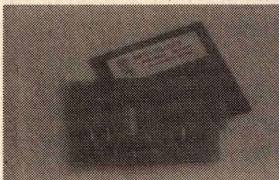
PC SOLID STATE DISK

\$21 OEM (1k) eval kit 75.00
FLASH / RAM / EPROM
256K-16M PCMCIA/DIPS

No More Hangups...

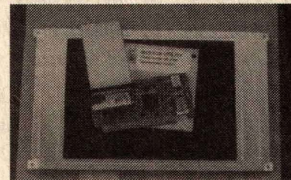
PC WATCHDOG!

Reboots PC OEM \$21 EVAL \$75



VGA LCD

640x480 controller
for PC or SBC
\$27 oem \$95 eval
combo LCD/CRT
version available



visit our web site: www.star.net/people/~mvs

MVS BOX 850
MERRIMACK, NH 03054
(508) 792-9507



5yr Limited Warranty
Free Shipping
Hrs: Mon-Fri 10-6 EST

Digital Oscilloscopes

100 MSa/s Parallel Port Based DSO

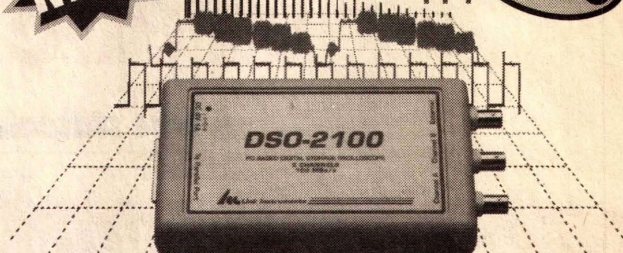
NEW!

2 Channels

100 MSa/s

FFT

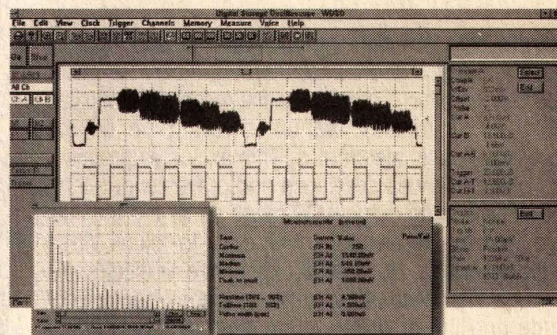
\$499



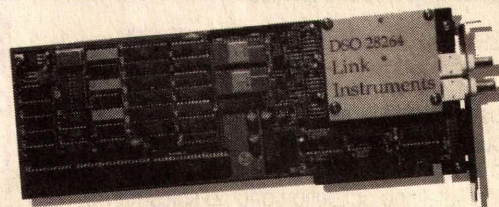
- 2 Ch. Digital Oscilloscope
- 100 MSa/s Max Single-Shot Rate on Both Channels
- 60MHz Input Bandwidth
- 32K Samples Per Channel
- Optional FFT Spectrum Analyzer*, Advanced Math* and TV Line Trigger**
- IEEE Pulse Parameter Measurements
- One touch Auto-Setup
- Advanced Pulse Triggering*
- Hands-Free Voice Control
- Easy to use Windows and DOS Software Included
- Parallel Port Interface to Laptop or Desktop PC
- Small and Lightweight (9 oz and 6.3" x 3.75" x 1.25")
- Free Demo Software on Web

For \$499 you get the model DSO-2102S Oscilloscope, Probes, Interface Cable, Power Adapter, and Windows and DOS Software.

*DSO-2102M \$599 **TV-Line Module \$149



DSO w/Logic Analyzer (ISA based)



- 200 MSa/s Max Single-Shot Sample Rate
- 2 Oscilloscope Channels
- 8 Logic Analyzer Channels
- 10 Channels Simultaneously
- 125 MHz Single Shot Bandwidth
- Up to 128K Samples/Channel
- FFT Spectrum Analyzer included

DSO-28264 (10Ch, 200MSa/s, 64k) \$1999

DSO-28464 (20Ch, 200MSa/s, 64k) \$3799

All prices include Probes and Software



Link Instruments (973) 808-8990

369 Passaic Ave. • Suite 100 • Fairfield, NJ 07004
www.LinkInstruments.com/en9 • Email: Sales@LinkInstruments.com

CIRCLE 330 ON FREE INFORMATION CARD

EPROM+ *The Professionals Choice!*

A rugged device programming system for bench and field

Uses parallel printer port!

Supports all standard parts!

Excellent, easy-to-use software!



IMPROVED!
New features,
more devices

FIRST GENERATION EPROMS 2708, TMS2716*, 25XX
SECOND GENERATION EPROMS (24, 28, 32 PIN) 2716 - 27C080 (8 MEG) *ADAPTER REQUIRED
16 BIT EPROMS (40, 42 PIN) 27C1024 - 27C160 (16 MEG) DIAGRAMS INCLUDED
FLASH EPROMS (28, 32 PIN) 28F, 29C, 29EE, 29F FAMILIES PLUS BOOT BLOCK DEVICES
EEPROMS/NVRAMS (24, 28, 32 PIN) 28C04 - 28C010, X2210/12, ER5901, PLUS DALLAS 12XX
SERIAL EEPROMS* (8, 14 PIN) 17XX, 24XX, 25XX, 35XXX, 59XX, 85XX, 93XX, 95XX+ER1400
BIPOLAR PROMS* (16 - 24 PIN) 74SXXX AND 82SXXX FAMILIES
MICROCONTROLLERS* (ALL FAMILIES) 874X, 875X, 87C5XX, 87C75X, 89C5X, 89C051
 89SXXX, 90SXXX, 68705, 68711, PIC12CXXX - 16CXXX, 17C4X PLUS FLASH AND 14000

- READ, PROGRAM, COPY, COMPARE, FILE LOAD/SAVE (PLUS MUCH MORE!)
- FULL SCREEN EDITOR W/25 CMDS + BYTE/WORD MODES
- RUNS UNDER DOS, WIN3.1/95/98 AT ALL CPU SPEEDS
- SUPPORTS INTEL HEX, S-RECORD AND BINARY FILES
- MADE IN USA • 30 DAY MONEY BACK GUARANTEE

\$289

SYSTEM INCLUDES: PROGRAMMING UNIT, PRINTER \$5.00 SHIPPING + \$5.00 C.O.D.
PORT CABLE, POWER PACK, SOFTWARE & MANUAL VISA+MASTERCARD+AMEX

ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OH 45150
 (513) 831-9708 FAX (513) 831-7562 website - www.arlabs.com

Help protect our nation's soil and water.
 Call for your free action packet.

1-800-THE-SOIL

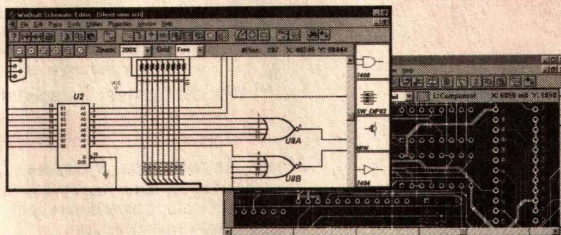
WE OWE IT TO OUR CHILDREN

United States Department of Agriculture
 Soil Conservation Service

Electronic CAD

You could pay up to ten times more for many of the same features that you get with these innovative design tools.

\$29.95



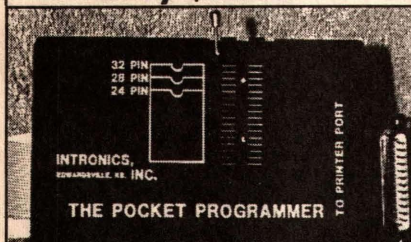
Over 25,000 people use WinDraft Schematics and WinBoard PCB layout tools for Windows. Now, you can buy a special 200 pin version of these best selling Windows based tools for only \$29.95 each.

You get everything you need to complete your circuit designs at an affordable price and it's easy to expand as your designs grow.

For the name of your local NTE distributor, Call 1-800-683-6837, or browse the internet www.ivex.com/nte.html



The Pocket Programmer Only \$129.95



The portable programmer that uses the printer port of your PC instead of an internal card. Easy to use software that programs Eeprom, EEprom, Flash & Dallas Ram. 27(C) / 28(C) / 28F / 29F / 29C & 25XX series from 16K to 8 Megabit with a 32 pin socket. Adapters available for Pic, PLCC, 5-Gang, 874X, 875X MCU's, 40-Pin X 16 & Serial Eeprom's, 82/74 Prom's and Eeprom Emulator to 32K X 8.

Same Name, Address & Phone # for 16 Years... Isn't it Amazing ?

Intronics, Inc.

Box 13723 / 612 Newton St.
 Edwardsville, KS 66113 Add \$5.00 COD
 Tel. (913) 422-2094 Add \$4.00 Shipping
 Fax (913) 441-1623 Visa / Master Charge

Turn Your Multimedia PC into a Powerful Real-Time Audio Spectrum Analyzer

Features

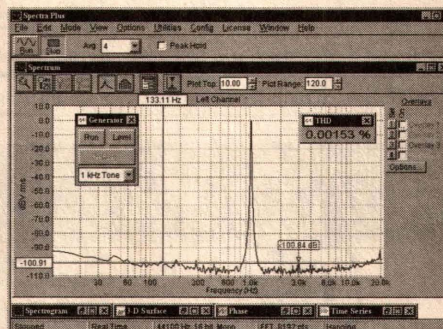
- 20 kHz real-time bandwidth
- Fast 32 bit executable
- Dual channel analysis
- High Resolution FFT
- Octave Analysis
- Distortion measurements
- Signal Generation
- Triggering, Decimation
- Transfer Functions, Coherence
- Time Series, Spectrum Phase, and 3-D Surface plots
- Real-Time Recording and Post-Processing modes

Applications

- Distortion Analysis
- Frequency Response Testing
- Acoustic Research

System Requirements

- 486 CPU or greater
- 8 MB RAM minimum
- Win. 95, NT, or Win. 3.1 + Win.32s
- Mouse and Math coprocessor



Priced from \$495

(U.S. sales only - not for export/resale)

DOWNLOAD FREE 30 DAY TRIAL!

www.spectraplus.com



Pioneer Hill Software
 24460 Mason Rd.
 Poulsbo, WA 98370
 a subsidiary of Sound Technology, Inc.

Sales: (360) 697-3472



Spectra Plus
 FFT Spectral Analysis System

Fax: (360) 697-7717

e-mail: pioneer@telebyte.com

The World's Largest Source for Home Automation

- The Best & Most Comprehensive Home Automation Catalog in the Industry
- Best Customer Service & Technical Support

FREE

144 page full color catalog!



Thousands of hard-to-find automation, X-10 and wireless control products. Computer interfaces, software, development tools, lighting control, telephone systems, security systems, surveillance cameras, infrared audio/video control, home theater, touchscreen control, HVAC, pet care automation, wiring supplies, books and videos and much more!

World's Largest Selection!

Lowest Prices Guaranteed!

HOME AUTOMATION SYSTEMS, INC.

Questions: 714-708-0610 Fax: 714-708-0614

e-mail: catalog@smarthome.com

www.smarthome.com

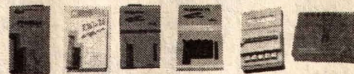
Call for a **FREE** Catalog! 800-762-7846

800-SMART-HOME

Dealers/Resellers ask about our
HASPRO Dealer Program 800-949-6255

PROGRAMMERS OVER 50 MODELS

ADVANTECH EETOOLS NEEDHAMS DATA I/O ICE TECHNOLOGY HILO SYSTEM GENERAL CHROMA MODULAR CIRCUIT TECHNOLOGY XELTEK



PROMAX EMP-20 MEGAMAX MEGAMAX4 SIMM/SP TESTER EMUPA

CALL ADVANTECH LABTOOL	599 EETOOLS SIMMAX
629 ICE TECH MICROLV	795 CHROMA SIMM/SP
650 EETOOLS ALLMAX +	359 MOD-MCT-EMUPA/R
409 EETOOLS MEGAMAX	279 MOD-MCT-EMUP/R
509 EETOOLS MEGAMAX4	49 EPROM 1G TO 512K
369 XELTEK SUPERPRO II	69 EPROM 1G TO 1MEG
409 XELTEK SUPERPRO II P	99 EPROM 4G TO 1MEG
249 XELTEK SUPERPRO L	199 EPROM 16G TO 1 MEG
165 XELTEK ROMMASTER II	89 EPROM 1G TO 8MEG
479 MOD-MCT-EMUPA	129 EPROM 4G TO 8MEG
739 STAG ORBIT-32	250 EPROM 8G TO 8MEG



LABTOOL48 MICROMASTER SUPERPRO ALLMAX PLUS ROMMASTER2

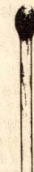
General Device Instruments

Sales 916-393-1655 Fax 916-393-4949 BBS 983-1234

Web www.generaldevice.com E-Mail icdevice@best.com



One tree can make
3,000,000 matches.



One match can burn
3,000,000 trees.

Use Your PC to Monitor and Control Your Environment

PC Host Adapter



RS232 to 1-Wire™ protocol host adapter interface. Converts standard PC serial port to a 1-Wire™ network. All interface components are contained inside the DB9 shroud. The HA3 supports all Point Six Products.

- No external power required.
- Includes OneSix™ DDE Server Software.
- Connects to 9 pin RS232 port on the PC.
- 2000' Network and 200 1-Wire™ devices.
- Weight 0.5 lb.
- One-year warranty.

OneSix™ DDE Server



A software server driver for Windows® 95, 3.1 and 3.11 that allows easy interface of 1-Wire™ devices and Point Six products to applications via DDE links. This eliminates the need for low level device communication programming.

- Searches network, adds and auto configures all new devices found.
- Copy and paste links to Office® products like Excel®, Word® and many other DDE capable applications.
- Works with HMI interface software such as Wonderware®, LabView®, and TestPoint®.
- Includes complete help.
- Includes an HA3 Host Adapter.
- Weight 0.5 lb.
- One-year warranty.

1-Wire™ Probes



STP010

Our probe designs are based on 1-Wire™ protocol devices. All probes are multi-dropable and supported by OneSix™ DDE Server Software.

- Digital Data Output.
- Built-in multi-drop controllers.
- All Data is CRC16 error checked.
- Unique device addressing.
- Calibration data stored in internal ROM memory.
- No external power required.
- Standard Temperature Range -30 to +182°F.
- Requires Host Adapter or existing network.
- Weight 1.0 lb.
- One-year warranty.

Very Low Cost Per Point Temperature Monitoring

Item	Description	Price
HA3	Host Adapter	65.95
ONESIX	DDE Server Software Driver	65.95
T1SS	Single Channel Digital I/O Solid State Relay Backplane	23.95
STP010	Standard Temperature /W 10' Lead	14.95
STP025	Standard Temperature /W 25' Lead	16.95
PRP001	Pressure Probe 0-30 PSI Absolute	159.95
PHP001	pH Probe 0-14pH	159.95
HMP001	Humidity Probe 0 - 100% RH	159.95
FCP001	Force Probe 1500gm	179.95
DS1820	Digital Thermometer Chip	3.49

Example: 25 Digital Thermometer Chips, 1000ft Cat-5 Cable, HA3 Host Adapter, OneSix™ DDE Server Software Driver, and Windows® Monitoring Application all for less than \$10 per point.

Two wire multi-drop network based on
Dallas Semiconductor 1-Wire™ Protocol



<http://www.pointsix.com>

Point Six, Inc. To Place An Order Contact Us At 138 E. Reynolds Road Lexington, KY 40517 Phone: 606-271-1744 FAX: 606-271-4695 E-Mail: sales@pointsix.com

CAD FILES TO CASH PILES

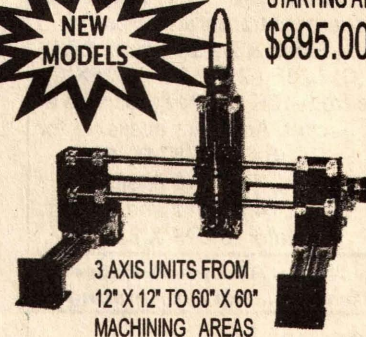


IMAGINE THE POSSIBILITIES!

ROUTE, MILL, DRILL, CARVE,
ENGRAVE, PAINT, ETC.
IN WOOD, PLASTIC, VINYL,
PC BOARD, & LIGHT METALS.

THE ROBOPRO X50 CNC ROBOTIC MACHINING SYSTEM

YOUR WISH IS ITS COMMAND!



STARTING AT
\$895.00

3 AXIS UNITS FROM
12" X 12" TO 60" X 60"
MACHINING AREAS

Visit us at
www.uscyberlab.com

U. S. CYBERLAB, INC., 14786 SLATE GAP RD., WEST FORK, AR 72774
VOICE (501) 839-8293 / 24 HR. FAX BACK (501) 839-8293

Roger's Systems Specialist

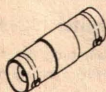
Silicone Grease

Heat transfer silicone grease for placing between heat sink and fan.

#TM-GUP.....\$1.00



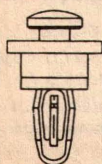
BNC Coupler



BNC, female-female, for use with networks and video applications.

#AD-546.....2/\$1.00

Standoffs



Nylon motherboard standoffs, 10 piece bags.

#CN-475.....\$1.00/bag

Mouse Pad

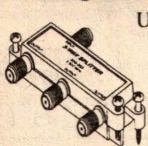
Sponge rubber backing to prevent sliding, many colors available, call for details.



#TM-PAD.....\$1.00 each

CALL TODAY FOR A FREE COPY OF OUR 1998 CATALOG WITH OVER 200 NEW PRODUCTS!

Signal Splitter

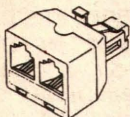


UHF/VHF/FM, 3-WAY, 5-900MHZ

#VA-503
\$1.00 each

Line Splitters

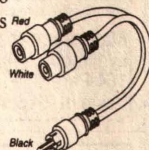
6 conductors, 2-females-1 male, plug a modem and telephone into the same outlet.



#TE-216.....\$1.00 each

RCA Splitter

1-RCA male to 2-RCA females
Shielded,



#AC-525
2/\$1.00 each

Motherboard Standoff

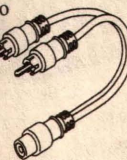
Brass, M/F threads for mounting of motherboards, 10 piece bag.



#CN-471.....\$1.00/bag

RCA Splitter

1-RCA female to 2-RCA male
Shielded,



#AC-526
2/\$1.00 each

"Bean" Splice

Telephone crimp splice, 10 piece bag



#TE-900
\$1.00/bag

"F" Connectors

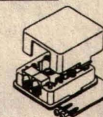
Crimp type for TV cable, attached crimp sleeve, RG-6



#CN-534.....5/\$1.00 each

Telephone Jack

Duplex modular surface jack, RJ-11, 4 conductors



#TE-SJ2.....\$1.00 each

Case Stickers

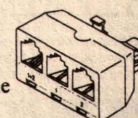
1" x 1" Stickers for front of computer cases. Many styles available. Get them made with your logo. Call for details.



#TM-STK.....\$1.00 each

Telephone Adapter

Line 1/Line 2 Splitter, RJ-11, Splits two phone numbers out of one jack.



#TE-212.....\$1.00 each

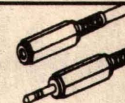
Solder

60/40 Electronic solder, dispenser tube, rosin core, 5 ft.



#TM-304
\$1.00 each

Audio Cable



Stereo extension cables, for speakers and headphones. 3.5mm, male to female, shielded, 6 ft.

#AC-559.....\$1.00 each

RCA Coupler

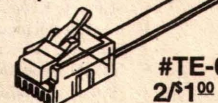
Female to female, gold plated



#AD-554.....2/\$1.00 each

Telephone Cable

7 ft. RJ-11 modular telephone cord.



#TE-074
2/\$1.00 each

Local 805-295-5577

Remember, We Have Great Connections...For You!

FAX 805-295-8777



\$10.00 minimum order required • Add \$4.50 shipping for pre-paid orders
California residents add 8.25% tax • eMail sales@rogerssystems.com



Call for quantity discounts • No out of state checks accepted • Most orders shipped same day!

24895 Avenue Rockefeller, Valencia, CA 91355



Interactive catalog: www.tokview.com

TV cable CONVERTERS & EQUIPMENT

NYE Electronics

(800)739-2253

* 30 days money back guarantee
* 1 yr warranty
* Quantity Discounts
* Dealers Welcome!

VISA MC AMEX C.O.D.

Since 1965, we've worked to make sure all children have the opportunity to learn valuable lessons during the years when it's easiest for them to learn. To find out how you can help, call your local Head Start.



Nurture the future
BE A HEAD START VOLUNTEER



!!!BROADCAST FARTHER!!!

The model 220 is an 80-110 MHz RF amplifier that connects to mono or stereo FM transmitters and produces a powerful 2-15 watt signal which could broadcast up to 5 miles or more! Requires 50-150 mW drive. Step by step plans complete with part source information and antenna designs... **ONLY \$14 PLUS \$2 S&H NO C.O.D.***

Progressive Concepts
Box 588 STREAMWOOD, IL 60107
(630)736-9822 FAX: (630)736-0353

VISA MasterCard American Express

SURVEILLANCE HIDDEN CAMERAS
DIRECT FROM MANUFACTURER - BEST PRICE IN THE MARKET

Ultra miniature hidden camera, in dome, smoke or motion detector w/ mic. B/W or Color. Wide view angle. Low light sensitivity + super sharp images, plus video and audio output. From \$159.00. Also 1/2" B/W board cameras, video, only \$99.00 USD. Wireless hidden camera, start at only \$249.00 USD. Plus \$5.95 for S/H. Wholesale Welcome. C.O.D., Check, Money Order or Visa/MC.

BOLIDE INTERNATIONAL CORPORATION
PH: (800) 355-0895 or (626) 575-8178
9660 Flair Drive #218, El Monte, CA 91731
<http://www.bolideamazingproducts.com/>

Low Cost PICmicro Tools



EPIC Pocket PIC Programmer - \$59.95
♦ Programs PIC12C50x, 67x, 16C55x, 6x, 7x, 8x

PICProto Boards - \$8.95 to \$17.95

PicBasic Compiler - \$99.95

new! PicBasic Pro Compiler - \$249.95

BASIC makes it easy for you to program the fast and powerful Microchip PIC microcontrollers.

- ♦ Expanded BS1/2 compatible instruction set
- ♦ True compiler provides faster program execution and longer programs than BASIC interpreters

microEngineering Labs, Inc.

Box 7532 Colorado Springs CO 80933

(719) 520-5323 fax (719) 520-1867

<http://www.melabs.com>

VISA

MasterCard

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

MC

AmEx

C.O.D.

5 Axis Robotic Arm Kit \$195.00



Build your own functional Robotic Arm

The kit comes complete with all hardware, base enclosure, structural components, 6 Hitec servos, SSC servo controller, Quick Basic software and an illustrated assembly manual. This robotic arm can be controlled from any micro with a serial port! It makes an excellent addition to a small mobile robot base. It is a great foundation for artificial intelligence experiments and teaching motion control. Check out our web site for more information and other robot kits.

- 3 Axis Version \$155.00
- Mobile Version \$250.00
- Mobile Robots Book \$48.00

Quantity discounts available. \$7.50 Shipping & Handling for USA, call for international and quantity shipping charges. IL residents add 6.25% sales tax to total.

Many more robot kits, ask for our free catalog!

Lynxmotion, Inc.
104 Partridge Road
Pekin, IL 61554-1403 USA



Tel: 309-382-1816
Fax: 309-382-1254
www.lynxmotion.com
jfrye@lynxmotion.com



World Passing You By?

Are you interested in Microprocessors & Embedded Control Systems? If not you should be! Look around, just about everything these days has an embedded microprocessor in it. TVs, cars, radios, traffic lights & even toys have embedded computers controlling their actions. The Primer Trainer is the tool that can not only teach you how these devices operate but give you the opportunity to program these types of systems yourself. Examples & exercises in the Self Instruction manual take you from writing simple programs to controlling motors. Start out in Machine language, then move on to Assembler, & then continue on with optional C, Basic, or Forth Compilers. So don't be left behind: this is information you need to know!

Examples Include:

- Measuring Temperature
- Using a Photocell to Detect Light Levels
- Making a Waveform Generator
- Constructing a Capacitance Meter
- Motor Speed Control Using Back EMF
- Interfacing and Controlling Stepper Motors
- Scanning Keypads and Writing to LCD/LED Displays
- Bus Interfacing an 8255 PPI
- Using the Primer as an EPROM Programmer
- DTMF Autodialer & Remote Controller (New!)

The PRIMER is only \$119.95 in kit form. The PRIMER Assembled & Tested is \$169.95. This trainer can be used stand alone via the keypad and display or connected to a PC with the optional upgrade (\$49.95). The Upgrade includes: an RS232 serial port & cable, 32K of battery backed RAM, & Assembler/Terminal software. Please add \$5.00 for shipping within the U.S. Picture shown with upgrade option and optional heavy-duty keypad (\$29.95) installed. Satisfaction guaranteed.

EMAC, inc.

11 EMAC WAY, CARBONDALE, IL 62901
618-529-4525 Fax 457-0110 BBS 529-5708
World Wide Web: <http://www.emacinc.com>

1985 - 1998
OVER
12
YEARS
OF SERVICE

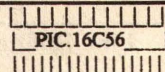
MICRO TEST, INC.

1800.931-9440

DIAGNOSTIC TEST CHIP

WE STOCK A COMPLETE LINE OF CHIPS, TOOLS, WIRELESS QUICK INSTALL TEST BOARDS AND DIAGNOSTIC CUBES FOR ALL CONVERTERS! ANYONE IMPLYING ILLEGAL USE WILL BE DENIED SALE. WE SELL PRODUCTS ONLY!! TO TECHNICIANS OR CABLE REPAIR FACILITIES!! IN CUSTOMER SERVICE & TECH. SUPPORT! ALL ORDERS SHIP WITHIN 24 HRS. UPS/FED-X. NEXT DAY SHIPPING AVAILABLE!!

WE STOCK CRITAL 119.MHZ
BEST PRICE IN THE MARKET
TEST BOARD STAR FROM \$9.95 INCLUDES SWITCH & RESISTER ECT. CREDIT CARDS ACCEPTED.
TECH SUPPORT 702-437-944 C.O.D. AVAILABLE.



2539 W. 237th Street, Bldg. F, Torrance, CA 90505
 Order desk only: USA: (800) 872-8878 CA: (800) 223-9977
 L.A. & Technical Info: (310) 784-5488 Fax: (310) 784-7590
 OEM INQUIRIES WELCOME

TIMELINE INC.

Over 12 years and 30,000 customers and still growing

Minimum Order: \$20.00. Minimum shipping and handling charge \$5.00. We accept cashiers checks, MC or VISA. No personal checks or COD's. CA residents add 8.25% sales tax. We are not responsible for typographical errors. All merchandise subject to prior sale. Phone orders welcome. Foreign orders require special handling. Prices subject to change without notice. 20% restocking fee for returned orders.

LIQUID CRYSTAL DISPLAYS

240x64 dot LCD with built-in controller.

AND 4021ST-EO. Unit is EL back-lit. \$59.⁰⁰ or 2 for \$109.⁰⁰ or OPTREX. DMF5005 (non back-lit) \$49.⁰⁰ or 2 for \$89.⁰⁰

20 character x 8 line 7/8L x 2 1/2H The built-in controller allows you to do text and graphics.

Alphanumeric—parallel interface

16x1	\$7.00	20x2	\$10.00	32x2	\$8.00
16x1 (lg. char.)	\$10.00	20x4	\$15.00	40x1	\$8.00
16x2	\$7.00	20x4 (lg. char.)	\$10.00	40x2	2 for \$20.00
16x2 (lg. char.)	\$10.00	24x2	\$10.00	40x4	\$20.00
16x4	\$15.00	32x4	\$10.00	4x2	\$5.00

5V power required • Built-in C-MOS LCD driver & controller • Easy "microprocessor" interface • 98 ASCII character generator • Certain models are backlit, call for more info.

Graphics and alphanumeric—serial interface

size	Mfr.	price	size	Mfr.	price
640x480 (backlit)	Epson	\$25.00	480x128	Hitachi	\$10.00
640x400 (backlit)	Panasonic	\$20.00	256x128	Epson	\$20.00
640x200	Toshiba	\$15.00	240x128 (backlit)	Optrex	\$20.00
480x128 (backlit)	ALPS	\$10.00	240x64	Epson	\$15.00
			160x128	Optrex	\$15.00

6" VGA LCD 640X480, Sanyo LMDK55-22 \$25.⁰⁰

MONITORS

Non-Enclosed TTL

Comes with pinout. 12V at 1.4 Amp input • Horizontal frequency 15KHz • Ability to do 40 and 80 column.
 5 inch Amber \$25.00 • 7 inch Amber \$25.00
 9 inch Amber or Green \$25.00

5" COLOR MONITOR \$39.⁰⁰

- Flat Faceplate • 320 x 200 Dot Resolution • CGA & Hercules Compatible
- 12 VDC Operation • 15.75 KHz Horiz. Freq. • 60 Hz Vert. Sync. Freq.
- Open Frame Construction • Standard Interface Connector • Degaussing Coil included • Mfr. Samtron

2 for \$69.⁰⁰

9" COLOR SVGA MONITOR \$249.⁰⁰ Fully Enclosed - Tilt and swivel type.

POS & BAR CODE

MAGNETIC CARD READER \$25.⁰⁰

Includes: • 20 character dot matrix display with full alpha-numeric capability • keypad with full alpha-numeric entry • separate 7.5 VDC/0.5 Amp power supply • standard telephone interface extension cord • lithium battery and flat-cone speaker.

HP bar code wand (HBGS 2300) \$25.00

HACKER CORNER

EMBEDDED 486 COMPUTER \$99.⁰⁰

Complete enhanced Intel 486SX-33 based computer in ultra small (9-7/8L x 6-5/8W x 3-1/8H) case. Ideal for embedded operations or as a second computer. Features include: • One 16 bit ISA slot • 3 serial ports plus dedicated printer port • Parallel optical coupled adapter port • Built in IBM PC/AT keyboard port • On board VGA video and port • Uses standard SIMM up to 32 MB • BIOS is PC/AT compatible

Unit has a backup Ni-Cd battery system in case of power failure (5 min. backup time) and lockable front cover to prevent floppy drive access. Mounting / interface provisions for standard 3.5" laptop floppy and 2.5 inch hard drives. Comes with very comprehensive manual.

SONY Miniature Color LCD Display (LCX005BK) \$29.⁰⁰

• 1.4 CM (0.55 inch) Diagonal Full Color Display • Built In Horizontal and Vertical Drivers • Delta Dot Pattern for High Picture Quality - 537 dots (H) x 222 dots (V) • Compatible with NTSC & PAL Format and Sync Inputs • 12 VDC Operation with -1 to +17 V RGB Signal and Driver Input Voltage • Excellent Display for Virtual Reality Projects, Viewfinders, and Miniature Test Equipment Displays • Pin Outs and Specification Included • Unit Requires Clock, Synchronization and Video

CELL SITE TRANSCEIVER \$49.⁰⁰ 2 for \$99.⁰⁰

These transceivers were designed for operation in an AMPS (Advanced Mobile Phone Service) cell site. The 20 MHz bandwidth of the transceiver allows it to operate on all 666 channels allocated. The transmit channels are 870.030-889.980 MHz with the receive channels 45 MHz below those frequencies. A digital synthesizer is utilized to generate the selected frequency. Each unit contains two independent receivers to demodulate voice and data with a Receive Signal Strength Indicator (RSSI) circuit to select the one with the best signal strength. The transmitter provides a 1.5 watt modulated signal to drive an external power amplifier. Channel selection is accomplished with a 10 bit binary input via a connector on the back panel. Other interface requirements for operation are 26 VDC (unregulated) and an 18.990 MHz reference frequency for the digital synthesizer. The units contain independent boards for receivers, exciter, synthesizer, tunable front end, and interface assembly (which includes power supplies and voltage-controlled oscillator). Service manual, schematics and circuit descriptions included.

LASER PRODUCTS

HeNe Laser Head (10mw max. output) TEMOO, 15.5" long MFG: NEC \$89.⁰⁰

Laser Power Supply (for HeNe tube) \$79.⁰⁰

LASER SCANNER ASSEMBLY \$19.⁰⁰

Assembly intended for a laser printer. Includes laser diode, polygon motor (6 sided) and misc. optics and lenses.

LASER DIODE (5mW) with collimator \$20.⁰⁰

VISIBLE LASER DIODE: 5mw at 670nm \$15.⁰⁰

Index guided. Threshold current 40 ma typical.

3 and 4mW, 1,300nm LASER DIODES, 5.6mm package, \$15.⁰⁰

Mitsubishi Electric part number ML701BIR-E21A, General specs are:

1. Vop=1.25, Beam Divergence 25.6° x 28.6°; 2. Tc=24°C, Iop=19 to 20mA, ITH=10.7mA;
3. Wavelength range between 1,280nm and 1,330 nm

POLYGON MOTOR UNIT & DRIVER \$69.⁰⁰

Ten-sided first surface mirror mounted on an armature that spins at 125 revolutions per second yielding a beam sweep rate of 1250 sweeps per second. The driver for the polygon unit requires 24 volts and plus and minus 12 volts to operate. There is also an f-theta lens in front of the polygon scanning mechanism with a three inch diameter. Great for optical experiments, etc. Very high quality units. (MFR: JAPAN ELECTRONICS)

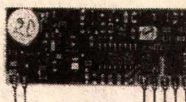
RF Data Modules

- ERP 0.25mW into 50Ω
- 3V(F), 5V(F) or 6-12V(A)
- 418 or 433.9MHz FM
- simply add antenna, data, power
- Range up to 200m
- Analog or digital data i/p
- SAW controlled - stability
- 10 x 30 x 5mm



TXM-4xx-A \$24.50
 TXM-4xx-F..... \$25.80

- Only 21 x 47 x 5mm
- 13mA; 130µA on power save (100:1)
- Carrier detect o/p
- 418 or 433.9MHz FM Superhet.
- SAW controlled - stability
- Analog or digital o/p
- Wide supply range 4.5-9V (A/F ver.)
- Fast enable time <3ms



SILRX-4xx-A \$39.38
 SILRX-4xx-F..... \$41.92

- Only 23 x 33 x 11mm
- Up to 40,000bps of balanced code
- Up to 170m range.
- 5V operation
- 418 or 433MHz FM
- Direct interface to 5V CMOS logic
- Fast 1ms enable from power saving



BIM-4xx-F..... \$87.36

- 3 wire RS232 interface
- Up to 38400 bps
- 418 or 433MHz FM. 7.5-15Vdc
- TX/RX LED indication
- Up to 150m range



CYPHERNET-RS232 \$139.30



ABACOM
TECHNOLOGIES

Free Catalog

Tel: (416) 236 3858

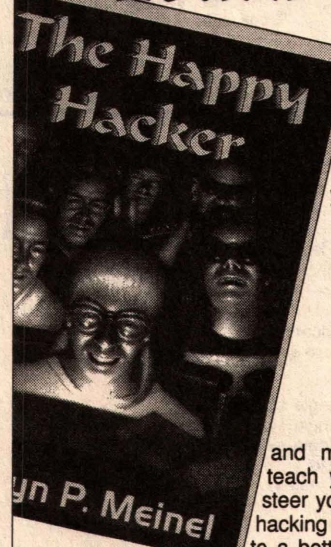
FaxBack: (416) 231 9681

Fax: (416) 236 8866

32 Blair Athol Cres, Etobicoke, ON, M9A 1X5, Canada

MasterCard / Visa

Learn to Hack!



Finally, here is a non-nonsense technical book on computer hacking! In it you will learn how to hack computers you have physical access to and how to hack on the Internet. With this book, you will learn about:

- Finding computers to hack
- Breaking into computers
- Hacking with Finger
- Port surfing
- Mapping the internet
- Forging E-mail
- Fighting spam
- E-mail bombs
- Hacker wars

and more! But this book will also teach you how to hack safely. It will steer you clear of the law, so that your hacking career won't lead to prison, but to a better job! By far, the best book on hacking available today!

266 PAGE PAPERBACK, \$29.95 SHIPPING \$3

Call (800)719-4957 now!

to order (Visa/MC/COD) or call or write for FREE CATALOG of hard-to-get information about computer viruses, computer hacking, security and cryptography!!

Check our web site: www.logoplex.com/resources/ameagle

American Eagle Publications, Inc.

P. O. Box 1507, Dept E.

Show Low, AZ 85902

September 1998, Electronics Now

Our Complete
Catalog is
now
online

www.cir.com

**Circuit
Specialists
Inc.**

**SINCE
1971**

**Check Out
What
We
Have
To Offer:**

Fantastic DMM Offer!!!

Don't let the price fool you. This meter is a digital multimeter designed for engineers and hobbyists. Equipped with 5 functions and 19 ranges. Each test position is quickly and easily selected with a simple turn of the FUNCTION/RANGE selector rotary switch.

General Rubber Boot Included
Display: 3-1/2 Digit LCD, 21mm Figure Height
with Automatic Polarity

Overrange Indication: 3 Least Significant Digits Blank

Temperature for Guaranteed Accuracy:
23°C±5°C RH<75%

Temperature Ranges:

Operating: 0°C to 40°C (32°F to 104°F)

Storage: -10°C to 50°C (14°F to 122°F)

Power: 9V Alkaline or Carbon-Zinc
Battery (NEDA1604)

Low Battery Indication: BAT on Left of
LCD Display

Dimensions: 188mm long x 87mm wide x
33mm thick

Net Weight: 400g

DC Voltage (DCV)

Range: Resolution: Accuracy:

200mV 100µV

2000mV 1mV

20V 10mV

200V 100mV

1000V 1V

Maximum Allowable Input: 1000V DC
or Peak AC.

DC Current (DCA)

Range: Resolution: Accuracy:

200µA 100nA

2000µA 1µA

20mA 10µA

200mA 100µA

10A 10mA

Overload Protection: mA Input. 2A/250V
fuse.

\$19.00

any qty

Resistance (Ω)

Range: Resolution: Accuracy:

200Ω 100mΩ

2000Ω 1Ω

20KΩ 10Ω

200KΩ 100Ω

2000KΩ 1KΩ

20MΩ 10KΩ

Maximum Open Circuit Voltage: 2.8V

Diode Test

Measures forward voltage drop of a
semiconductor junction in mV test current
of 1.5mA Max.

hFE Test

Measures transistor hFE.

Frequency Range: 45Hz-450Hz

Maximum Allowable Input: 750V rms

Response: Average Responding. Calibrated
in rms of a Sine Wave.

AC Voltage (ACV)

Range: Resolution: Accuracy:

200V 100mV

750V 1V

Our
Best
Offer
Ever
on a

High
Quality
Full Sized
DMM

CAT NO	DESCRIPTION	PRICE
9300G	Rugged High Quality DMM with Rubber Boot	\$19.00

Positive Photofabrication Kit Make your own PCB's

Kit includes the basic items needed to fabricate pre-sensitized printed circuit boards (does not include artwork). Also included is a basic process guide to assist the user in the basics of exposing, developing and etching a PCB. All items fit conveniently in the plastic development tray, and a tight fitting lid is included for handy storage. Additional recommended supplies for fabricating PCB's are: exposure bulb, etchant tank, eye protection, art-work, paper towels.

Kit Includes

- 1 each 3"x5" pre-sensitized single sided PCB
- 1 each 4"x6" pre-sensitized single sided PCB
- 1 each 6"x6" pre-sensitized single sided PCB
- 1 each 500ml developer liquid
- 1 each 500ml ferric chloride etching liquid
- 2 each foam brushes
- 1 each plastic development tray
- 1 each rubber gloves
- 1 each instruction sheet

CAT NO	DESCRIPTION	PRICE
416-K	Photofabrication Kit	\$27.95

CIRCUIT SPECIALISTS, INC.

SINCE 1971

800-811-5203

602-464-2485

602-464-5824(FAX)

WE ACCEPT:



RECEIVE OUR LATEST 132 PAGE CATALOG!

It's chock full of all types of electronic equipment and supplies. We've got I.C.'s, capacitors, resistors, pots, inductors, test equipment, breadboarding supplies, PC supplies, industrial computers, data acquisition products, personal computers and computer parts, plus much, much more. FAX us your name and address or call **800-811-5203, ext. 5**, to leave a message on our catalog request line.

Positive Photo Resist Pre-Sensitized Printed Circuit Boards



These pre-sensitized printed circuit boards are ideal for small production runs. They provide high resolution and excellent line width control. High sensitive positive resist coated on 1oz. copper foil allows you to go direct from your computer plot or art work layout. No need to reverse art.

Single-Sided, 1oz. Copper Foil on Paper Phenolic Substrate

CAT NO	DESCRIPTION	1	10	50
PP101	100mm x 150mm/3.91" x 5.91"	\$2.55	\$1.90	\$1.70
PP114	114mm x 165mm/4.6" x 6.6"	2.98	2.45	1.98
PP152	150mm x 250mm/5.91" x 9.84"	5.40	3.98	3.60
PP153	150mm x 300mm/5.91" x 11.81"	6.15	4.48	4.10
PP1212	305mm x 305mm/12" x 12"	12.78	10.65	8.52

Single-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	1	10	50
GS101	100mm x 150mm/3.91" x 5.91"	\$ 3.90	\$2.98	\$2.60
GS114	114mm x 165mm/4.6" x 6.6"	4.80	3.49	3.20
GS152	150mm x 250mm/5.91" x 9.84"	8.69	5.98	5.78
GS153	150mm x 300mm/5.91" x 11.81"	10.20	7.20	6.80
GS1212	305mm x 305mm/12" x 12"	18.88	15.73	12.59

Double-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	1	10	50
GD101	100mm x 150mm/3.91" x 5.91"	\$ 5.07	\$3.68	\$3.38
GD114	114mm x 165mm/4.6" x 6.6"	5.95	4.29	3.99
GD152	150mm x 250mm/5.91" x 9.84"	10.47	7.39	6.98
GD153	150mm x 300mm/5.91" x 11.81"	11.95	8.69	8.30
GD1212	305mm x 305mm/12" x 12"	22.09	18.35	14.68

Exposure System

Just place your presensitized board and artwork centered under the exposure fixture. Place the convenient acrylic sheet over the board and artwork to hold everything in place. Turn on light. Voila! Exposure takes about 5 minutes. Kit includes one fluorescent tube, stand and acrylic weight.

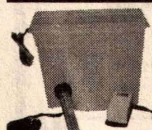


new!

Features

- Exposes boards in about 5 minutes!
- Convenient acrylic sheet to hold board in place during exposure (12.5" x 8.5")
- Fluorescent light fixture with plastic cover designed to aid in proper light refractions for even exposure

CAT NO	DESCRIPTION	PRICE
416-X	Fluorescent Exposure System	\$31.95
416-B	Extra Replacement Fluorescent Tube	\$6.95



Etching Tank

This handy etching system will handle PC boards up to 8" x 9", two at a time. Ideal for etching your PCB's! System includes an air pump for etchant agitation, a thermostatically controlled heater for keeping etchant at optimum temperature and a tank that holds 1.35 gallons of etchant. A tight fitting lid is also supplied to prevent evaporation when system is not being used. Typical etching time is reduced to 4 minutes on 1oz. copper board!

REDUCES ETCHING TIME!	CAT NO	DESCRIPTION	PRICE
	12-700	Etch Tank System	\$37.95

Developer This product is used as the developer on our positive photo-resist printed circuit boards. Includes instructions. 50 gram package, mixes with water, makes 1 quart.

CAT NO	DESCRIPTION	1	10	25
POSDEV	Positive Developer	\$.95	\$.80	\$.50

Etching Chemicals/Ferric Chloride

A dry concentrate that mixes with water to make 1 pint of etchant, enough to etch 400 sq. inches of 1oz board.

CAT NO	DESCRIPTION	1	5
ER-3	Makes 1 pint	\$3.50	\$2.75



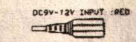
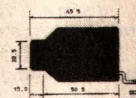
Color Weather Proof Bullet Camera

1/3" CCD with removable rotation capable mounting bracket

Specifications

Image Sensor: Interline transfer CCD 1/3" format
Effective Pixel: 512(H)x492(V) pixels/NTSC
512(H)x582(V) pixels/PAL
Scanning System: 2 : 1 interlaced
Sync System: Internal sync
Sync Pulse: 15.734KHz +1%(H)/15.625KHz +1%(H)
59.94Hz +1%(V)/ 50Hz +1%(V)
Sub-Carrier 3.57 MHz +30ppm
400 TV lines (H)
Resolution: More than 46dB (typ)
S/N Ratio: 0.45
Gamma Characteristics: 1 LUX (F1.2 10IRE)
Min. Illumination: Composite video signal :
Video Out: 1.0Vp-p
White Balance: Auto white balance
Electronic Shutter: 1/60 - 1/100,000 SEC(N) 1/50 - 1/100,000 SEC (P)
Power Supply: DC 12V + 10%
Power Consumption: 240mA (typ)
Lens: 4mm (78 or 92 degree) F : 2.0
Ambient Operating Temp: -5 deg. C +40 Deg. C
Ambient Storage Temp: -10 Deg. C +50 Deg. C RH 95% MAX
Dimension: 2 1/8" (L) x 1 1/4" (D)
Weight: 3 oz.

new!



CAT NO	DESCRIPTION	PRICE EACH	1	5
WDB-5407S	Color Water Tight Bullet Camera	\$299.00	\$299.00	\$299.00

(water tight for outdoor use, not suitable for sustained underwater use)

CCD Bullet Cameras

Available with standard or pinhole lens. Virtually indestructible bullet shaped casing. This sleek B&W camera can be mounted on walls or ceilings along narrow corridors or virtually any location for virtually any surveillance application. 0.5 lux minimum illumination with 380 lines of resolution. Even includes a built-in electronic iris for automatic light compensation.

Features

- Extremely low power consumption
- No blooming, no burning
- 0.5 LUX minimum illumination
- CCD area image sensor for long camera life
- Ultra small size allows for simple application and installation
- Built-in electronic auto iris for automatic light compensation
- Ultra compact camera

Specifications

Image Pick-Up Device: 1/3" CCD area sensor
No. of Pixels: EIA = 512(H) x 492(V)
Pixel Pitch: EIA = 9.6UM(H) x 7.5UM
Scanning System: EIA=525 lines, 60 field/sec
Sync System: Internal sync
H. Resolution: 430 TU line
V. Resolution: 400 TU line
Usable Illumination: 0.5 Lux F1.6
S/N Ratio: More than 48dB
Gamma Characteristic: 0.45
Video Output: 1.0 - 1.1 u-p 75 Ohm
Electronic Shutter Time: EIA=1/60 - 1/50,000 sec
Lens F No. Focal Length: STD : 1.6 Open / 4.3mm(78 deg) Pinhole: 4.3 fixed/ 2.8mm(91.4 deg)
Power Consumption: DC 9V (8-10V), 110mA
Operational Temp.: -10 deg - +50 deg C RH95% max
Storage Temp: -20 deg - +60 deg C RH95% max
Dimensions: STD : 22mm(W) x 22mm(H) x 38mm(D) Pinhole: 22mm(W) x 22mm(H) x 30mm(D)
Weight: 35g max

new!



CAT NO	DESCRIPTION	PRICE EACH	1	5
WDB-07S	Standard Lens Version	\$144.00	\$144.00	\$129.00
WDB-07P	Pinhole Lens Version	144.00	129.00	
WDP-07S/water	Standard Lens Weather Proof	169.00	152.00	

ESD Safe Soldering Stations

- Auto-Temp 136ESD & Auto-Temp 137ESD
- Meets applicable military standards
- ESD safe featuring ceramic heating element and state of the art P.T.C. sensor to ensure accurate temperature performance

Features

Fine Tune Temperature from 150° C (300° F) through 450° C (850° F) without unnecessary tip or heating element changes.

Precision "Tip Temperature" accuracy is mastered to within ±3° C (6° F) using state of the art circuit technology and a built-in P.T.C. sensor located at the top of each ceramic heater shaft for fail safe accuracy.

Fast Heat Up & Recovery. A long life Japanese made ceramic heating element facilitates fast heat up, fast recovery and exacting temperature control with minimal overshoot. Heat-up time to working temperature is attained in about 45 seconds. **Spoke Free Circuit.** "Zero voltage" switching and fully grounded design meets military application standards for protection of electrostatic sensitive devices against line transience and voltage spikes. Tip leakage is less than 0.4 mv or 0.5 ohm resistance. **External Calibration Port.** A calibration port is located on the face of the unit thus temperature adjustments are quick and convenient.

Lightweight Soldering Iron. Ergonomic mini handle that stays "cool". Handle assembly cord is made from silicone rubber that won't be damaged when coming into contact with high temperature irons.

Isolated Power Unit. The power unit is isolated from the AC line by a high quality



Standard Tip

CCD Dome Camera with Audio

B&W DOME camera with integrated microphone. Ideal security system application. 12 VDC operation.

Specifications

Image Device: 1/3" interline transfer CCD
Picture Elements: EIA=542(H)x492(V)
Scanning System: 2:1 Interlace
Synchronization System: Internal
Horizontal Resolution: 380 TV Lines
Sensitivity: Under 0.3 LUX
Electronic Iris (linear): EIA = 1/60-1/100,000 sec
Video Output: 1.0Vp-p, 75 ohm
S/N Ratio: More than 50dB
Power Supply: 12V DC (±20%)
Gamma: r=1
Power Consumption: 110 mA max
Operating Temp.: -10°C ~ +50° C
Operating Humidity: RH 95% Max
Weight: 100g
Applied Lens: 3.6mm -92°, 4.3mm -78°
AI/EE/Flicker Less/Mirror Image: Jump soldering selection
Audio Pick-up Sensitivity: -60dB (0dB=1V/ubar)
Audio Frequency Range: 20 Hz - 20 kHz
Audio S/N Ratio: More than 40dB
Audio Output Level: 1Vp-p/600 ohm
Dimensions: 87 x 55.5mm

new!



CAT NO	DESCRIPTION	PRICE EACH	1	5
WDDB-6500	B&W Dome Camera	\$144.00	\$144.00	\$129.00

1/3" CCD Board Cameras

Available with PINHOLE LENS with AUDIO; STANDARD LENS with AUDIO; and STANDARD LENS with INFRA-RED and AUDIO. These are the world's smallest commercially available CCD board cameras!

World's Smallest B&W Board Cameras

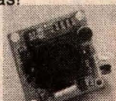
Specifications

Image Pick-Up Device: 1/3" CCD area Sensor
Picture Elements: EIA=512(H) x 492(V)
Pixel Pitch: EIA=9.6UM (H) x 7.5UM (V)
Scanning System: 2 : 1 Interlace
Scanning Frequency: EIA=525 lines, 60 field/sec (II) 15.750 KHz x 60 HK
Resolution: 430 Lines
Minimum Illumination: 0.03 LUX
S/N Ratio: 45DB
Lens Mounting: 4.3mm standard, 5mm pinhole
Video Output: 1.0 VP-P/750OHM composite signal
Power Requirement: 8-12 VDC (9VDC standard)
Power Consumption: 100mA
Operating Temperature: -20C → 70 C RH 95% Max
Storage Temperature: -40C → 85 C RH 95% Max
Audio Pick-Up Sensitivity: -60 DB (0DB = 1B/UBAR. 1KNZ)
Audio Frequency Range: 20 Hz to 20KHz
Audio S/N Ratio: More than 35DB
Audio Output Level: 1VP-P/600 OHM

Dimensions

WDP-2000 30mm (H) x 30mm (W)
WDS-2005 30mm (H) x 30mm (W)
WDI-4000 44mm (H) x 30mm (W)

CAT NO	DESCRIPTION	PRICE EACH	1	5
WDP-2000	1/3" B&W Pinhole Lens with Audio	\$89.00	\$89.00	\$77.00
WDS-2005	1/3" B&W Standard Lens with Audio	89.00	77.00	
WDI-4000	1/3" B&W Infra-RED with Audio	89.00	77.00	
WDPH-55BW	Plastic Housing Option for B&W Board Cameras (WDP-2000 & WDS-2005 ONLY)	13.00	12.00	



SEE OUR ON-LINE CATALOG AT
www.cir.com

CIRCUIT SPECIALISTS, INC. 800-811-5203
SINCE 1971 602-464-2485
602-464-5824(FAX)



XYTRONICS

136ESD

137ESD w/ Digital R/O

front panel. Superior High Insulation ceramic heater provides insulation rated over 100Mohms at 750° F. Optional SMD Tip Series for re-work applications. Range of Interchangeable Tips Available for maximum system flexibility.

SEE www.cir.com FOR OUR SELECTION OF REPLACEMENT TIPS, REPLACEMENT IRONS AND SMD TIPS.

CAT NO	DESCRIPTION	PRICE EACH	1	5
136ESD	Electronic Temp Controlled ESD Safe Soldering Station	\$99.00	\$99.00	\$88.00
137ESD	Electronic Temp Controlled ESD Safe Soldering Station w/ Digital Readout	129.00	114.00	

transformer and only 24 Vac voltage is used to drive the heating element. **ESD Safe.** Exceeds all soldering equipment military specifications regarding electro static sensitive devices for critical applications. **Lock-Out Feature:** Constructed with a lock-out feature to allow supervisors only to set and lock specific soldering temperatures. Accomplished via a special sized allen head screw located on the

Mark V Electronics, Inc.
8019 E. Slauson Ave.,
Montebello, CA 90640
Catalog 213/ 888-8988
Fax 213/ 888-6868
http://www.mark5co.com
Email: mark5co@aol.com

DIY Audio Electronic Kits
Lab Equipment kits
Audio Enclosures & more!
ORDER
1-800-521-MARK
1-800-423-FIVE

* 1/2 Shipping Order over \$ 100

Kit skill levels
Beginner
Intermediate
Advanced
- Fast Shipping
- Quality Kits low prices
- In business since 1985

Clearance Sale



Kit \$ ~~12.50~~ 6.99

This is a low power real FM transmitter. Transmit frequency within 88-108 MHz. Transmit range about 200 ft. It has high sensitivity sound pickup by a capacitance microphone. May be used strictly for series purposes such as remote wireless monitoring.

FM Wireless Microphone TY-35

Clearance Sale



Kit \$ ~~39.00~~ 20.00

This precision digital meter is a stand-alone voltmeter-ammeter or can interface with a computer! 4 1/2 digit 0.55" LED display. Temperature compensated to 100 PPM/°C. Operating temperature range is 0°C to +70°C. Outputs include BCD date, Busy and strobe. Panel reading can be latched on hold.

4 1/2 Digital LED Panel Meter SM-48

Stereo Loudspeaker Protector

TY-25 ▲



Kit: \$ 16.75

Super fast acting relay protects speakers against destructive DC voltages. Can connect directly to a power amplifier or can use a separate power supply. Has a 3 second turn-on delay to avoid turn-on thumps.

Regulated DC Power Supply

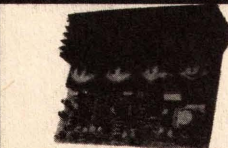
TR-503 ▲



Kit: \$ 18.75

It is short circuit proof & has overload protection. Output voltage is variable over a range of 0-50 volts. Current limit trip is adjustable up to max of 3A. May use Mark V #002 transformer.

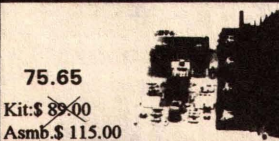
120-250W Mosfet Power Mono Amplifier AF-2 (6 lbs.) ▲▲



Kit: \$ ~~89.80~~ 76.33 Asmb. \$ 114.80

Power Output: 250W into 4 ohms RMS(42VX2 6A transformer is used). 120W into 4 ohms RMS(33VX2 4A transformer is used). Frequency Response: 3Hz-22,000Hz. THD: <0.03%. Signal to Noise Ratio: 91dB. Sensitivity: 1V RMS at 47k. Load Impedance: 4 or 8 ohms. Power Requirement: ±46VDC 4A or ±60VDC 6A. May use Mark V model 012 Transformer. Suggested Capacitor 8,200uf 100V Model 020. Suggested Metal Cabinet LG-1925.

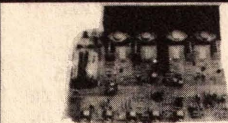
300W High Power Mono Amplifier TA-3600 (5 lbs.) ▲▲▲



75.65
Kit: \$ ~~89.00~~
Asmb. \$ 115.00

Power Output: 300W into 8 ohms RMS. 540W music power into 8 ohms. Frequency Response: 10Hz-20KHz. THD: < 0.05%. Sensitivity: 1V RMS at 47K. Power Requirement: 60 to 75 VDC at 8A. May use Mark V Model 007 or 009 Transformer. Suggested Capacitor: 8,200uf 100V Model 020 Capacitor. Suggested Metal Cabinet LG-1925.

120W + 120W Pre & Main Stereo Amplifier TA-800MK2 (4 lbs.) ▲▲



Kit: \$ ~~67.92~~ 61.13 Asmb. \$ 86.95

Power Output: 120W into 4 ohms RMS. 72W into 8 ohms RMS. Frequency Response: 10 - 20 KHz. THD: < 0.01%. Tone Control: Bass ±12dB, Mid ±8dB, Treble ±8dB. Sensitivity: Phono Input, 3mV into 47K. Line, 0.3V into 47K. Signal to Noise Ratio: 86dB. Power Requirement: 40V DC @ 6A. May use Mark V Model 001 or 008 Transformer. Suggested Metal Cabinet Model LG-1924.

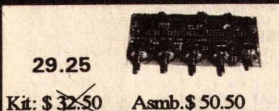
80W + 80W Pure DC Stereo Main Power Amplifier TA-802 (4 lbs.) ▲▲



42.45
Kit: \$ ~~49.94~~
Asmb. \$ 69.94

Power Output: 80W per channel into 8 ohms. THD: < 0.05%. Frequency Response: DC to 200 KHz, -0 dB, -3dB @ 1W. Power Requirement: 30V AC X 2 @ 6A. May use Mark V Model 001 or 008 Transformer. Suggested Capacitor 8,200uf 50V Model 017. Suggested Metal Cabinet LG-1924

30W + 30W Pre & Main Stereo Amplifier TA-323A (1 lb.) ▲



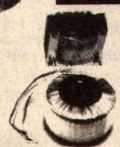
29.25
Kit: \$ ~~32.50~~ Asmb. \$ 50.50

Power Output: 30W into 8 ohms RMS per channel. THD: < 0.1% from 100 Hz to 10 KHz. Sensitivity: Phono 3mV @ 47K. Tuner, Tape 130mV @ 47K. Signal to Noise ratio: 80dB. Power Requirement: 22 to 36V AC, 3A. May use Mark V Model 002 Transformer. Suggested Cabinet LG-1684.

Metal Cabinets
Aluminum Front Panel

LG-1273	3x12x7"	(4 lbs.)	\$ 26.50
LG-1684	4x16x8"	(7 lbs.)	32.50
LG-1924	4x19x11 1/2"	(10 lbs.)	38.25
LG-1925	5x19x11 1/2"	(10 lbs.)	42.00
LG-1983	2 1/4x19x8"	(7 lbs.)	35.25
LG-1927	7x19x11 1/2"	(15 lbs.)	52.50

Transformers (5-12 lbs.)
**Toroidal Transformers



# 001	28V/30V x2	6A	\$ 30.00
# 002	36V x2	3A	25.00
# 003	40V x2	6A	32.00
# 008**	28V/30V x2	6A	42.00
# 009**	48/53V x2	8A	68.00
# 012**	33/40/42V x2	6A	52.00

Minimum order: \$ 20.00 We accept Visa, MasterCard, Money Orders, and Checks(allow 2 weeks for clearance). We ship by UPS ground inside US (min \$6.00) and ship by US mail outside US. Please call our operator for orders over 2 lbs. or foreign orders.

SCHOOL PROJECT CORNER
po orders welcome from schools

Melody Generator	▲	Kit \$ 13.85
6W Mini-Amplifier	▲	9.50
0-15V 5A Regulated DC PS	▲	17.50
36W Class A Power Amp.	▲▲	32.50
Dynamic Noise Reduction	▲	26.00
Multi-Function Control Switch	▲	10.50
20 Bar/Dot Level Display	▲▲	41.45
Microphone Mixer Mono Amp.	▲	20.79
Superior Electronic Roulette	▲	21.50
Digital Clock with Melody Alarm	▲	25.00
Stereo Pre-Amp with Mic Amp.	▲	10.78
Mini Stereo Multi-Input Amp.	▲	30.50
130-in-one Electronic Lab	▲	29.99

SEE OUR CATALOG FOR MORE KITS !

Fluorescent Light Driver

TY-2 ▲ (1 lb.)



Kit: \$ ~~14.75~~ 9.99

This unit drives 6-40 watts fluorescent light for portable and emergency use. Works from a 7.2 - 16 VDC battery. Includes a "Hi-Efficiency Switching Mode IC Driving Circuit" suitable for use with different lights.

500-in-one Electronic Lab Kit

KA-904 \$129.99



Contains its own computer with a simple explanation of the basic(Assembler) language required for operation. Compile programs to discover how computers operate while gaining an understanding of hardware & software. With easy-to-follow manual which explains by comprehensive diagrams. Requires 4 "AA" batteries.

150MHz 8 Digit Frequency Counter

SM-100 (2 lbs.)



Kit: \$ ~~79.00~~ 68.00
Asmb. \$ 99.00

It is used for adjustment, test & repair of any kind of high frequency circuit products. It can give up to 8 digit of resolution for a wide frequency range 10Hz - 150 MHz. The last input frequency can HOLD on the display for future reference & comparison. The circuit structure is compact & reliable for the most updated A/D LSI circuitry. The input impedance is 1M ohm.

60 + 60W Stereo Power Amp. ▲

SM-302 (11 lbs.)



It provides 3 input jack pairs. One pair accept a high impedance microphone. The two remaining pairs are for high & low level input sources. Power Output: 60W per channel into 4 ohms RMS. 20Hz-20KHz. THD:<0.1%. Input Sensitivity :Mic /Guitar 10mV, Hi 380mV, Lo 640mV. Ready to plug in when assembled.

300-in-one Electronic Lab Kit ▲▲



Learn about transistors, capacitors & electronic circuits. Build electronic games, battery checker & more. It even includes a breadboard for adding your own components. Complete with easy-to-follow manual. Requires 6 "AA" batteries. (6 lbs.)

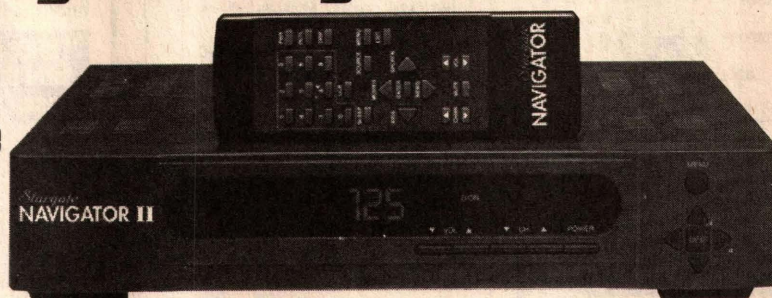
\$ ~~59.99~~ 49.99

The Only 100% Legal, FCC approved,
DESCRAMBLER you can buy!

NAVIGATOR II...

The only legal way to own your converter!

- 250 Channel Capacity
- Subscribe to two different cable systems simultaneously
- Interactive On-Screen Display
- Watch one premium channel while recording another
- Electronic program guide shows all programming over next 7 days
- One Touch Recording



NO RENTAL FEES!
Advanced Features!

**Most advanced
 set-top you
 can buy!**

FCC & UL Approved

**Save
 Money!**

DYNAMIC Technologies • Phone: 1-800-643-4258

Suite 541064 • Boystown, NE 68154

CIRCLE 312 ON FREE INFORMATION CARD

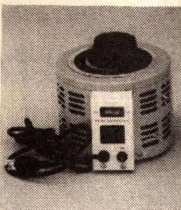
**C
 COMPILER** **\$49.00**
for PIC microcontrollers
 Supports PIC16C55x, 16C6x, 16C62x, 16C8x, 16C92x microcontroller families. Based on ANSI C standard. Supports arrays, unions, structures, pointers, strings, function calls, if, for, switch, while, interrupt vectors, in-line assembler code, 8 & 16 bit variables, etc. Outputs Intel Hex format and assembly code. Code optimizer included. Excellent development tool!
 732-873-1519 fax 732-873-1582 e: grichrc@aol.com
 Grich RC Inc. 120 Cedar Grove Ln, Ste 340, Somerset NJ 08873

Zagros Robotics
World Class Engineering and Programming
**ROBOTS
 SONAR
 OPTICS**
**Artificial
 Intelligence**
 PO Box 460342
 St. Louis, MO 63146-7342
 (314)768-1328
 info@zagrosrobotics.com
 www.zagrosrobotics.com

Digital Entertainment GREAT VALUES ON:
 USSB dish
SAVE Compare to Cable
30%-50%
 MORE ENTERTAINMENT OPTIONS
 ALL THE HOT ACCESSORIES
 PAY LESS
 1010 Frontier Dr.
 Fergus Falls, MN 56537
 Fax: 218-739-4879
 Int'l 218-739-5231
 Call Now 800-543-3025
 www.skyvision.com **Skyvision**

VARIAC

Excellent for controlling & testing various electronic products such as, Motor, Transformer, Lighting Control, School Electronics Lab / **1000VA**

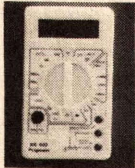


\$69.89

Qty. 3+

DIGITAL MULTIMETER

Basic Digital Multimeter with Transistor "hfe" and Continuity Test.



Qty. 3+ **\$8.50**

1-888-456-4517

Associated Elec. & Eng. Co./ AEEC

PO Box 4766,
Santa Clara CA 95056

MEASURE and CONTROL VIA SERIAL PORT



The ADR interfaces connect to any serial port and allows control and data acquisition using simple ASCII strings. Easy to use with BASIC, C, VISUAL BASIC. High current digital I/O drive LED's, solid state relays directly. Interface sensors to measure temperature, humidity, position, PH, pressure, etc. Control stepper motors with digital I/O or DC motors with PWM. Daisy chain versions for up to 320 digital I/O and 64 analog ch. **-Low-cost, systems \$99-\$250. Includes RS232 cable.**

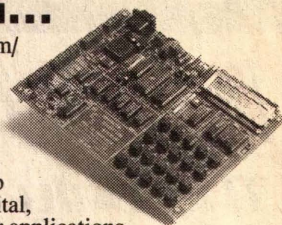
ONTRAK CONTROL SYSTEMS INC.
422 Amley St., Sudbury, Ontario
CANADA P3C 1E7
(705)671-2652, (705)671-6127(Fax)
tfortin@vianet.on.ca

Visit our web site for details, applications, schematics and programming examples.

www.ontrak.net

Learn MICROCONTROLLERS EMBEDDED SYSTEMS and PROGRAMMING...

...with the AES learning system/ embedded control system. Extensive manuals guide you through your development project. All programming and hardware details explained. Complete schematics. Learn to program the LCD, keypad digital, analog, and serial I/O. for your applications.



THREE MODELS AVAILABLE. Choose from an Intel 8051, Intel 8088, or Motorola 68HC11 based system. All models come with:

- 32K Byte ROM, 32K Byte RAM • 2 by 16 Liquid Crystal Display • 4 by 5 Keypad • Digital, Analog, and Serial I/O • Interrupts, timers, chip-selects • 26 pin expansion connector • Built-in Logic Probe • Power Supply (can also be battery operated) • Powerful ROM MONITOR to help you program • Connects to your PC for programming or data logging (cable included) • Assembly, BASIC, and C programming (varies with model) • Program disks with Cross Assembler and many, well documented, program examples • User's Manuals: cover all details (over 500 pages) • Completely assembled and ready to use • Source code for all drivers and MONITOR • Optional Text Book

Everything you need. From \$279.
Money Back Guarantee

Call for Free Info Pack, or see
WEB at <http://www.aesmicro.com>
714-550-8094, FAX 714-550-9941



Call 1-800-730-3232

AES 575 ANTON BLVD., SUITE 300, COSTA MESA, CA 92626, USA

The Electronic Experimenter's Journal

It's part catalog, part magazine and part data book with kits, parts, plans, articles, and application notes.

Call for your **FREE** copy today

Debco Electronics
4025 Edwards Rd.
Cincinnati, OH 45209

1 800 423-4499

CABLE TV CONVERTERS

*Equipment & Accessories
Wholesalers Welcome*

Call C&D ELECTRONICS
1-888-615-5757 M-F 10a-6p

Weeder Technologies

Add \$4
Ship/Hand
US & Canada

FREE CATALOG!



Pro-Kit

PO Box 2426, Ft. Walton Beach, FL 32549

850-863-5723

Stackable RS-232 Kits

Digital I/O - 12 I/O pins individually configurable for input or output. DIP switch addressable; stack up to 16 modules on same port for 192 I/O points. Turn on/off relays. Sense switch transitions, button presses, 4x4 matrix decoding using auto-debounce and repeat. **\$32**

Analog Input - 8 input pins. 12-bit plus sign self-calibrating ADC. Returns results in 1mV steps from 0 to 4095. Software programmable alarm trip-points for each input. DIP switch addressable; stack up to 16 modules on same port for 128 single-ended or 64 differential inputs. **\$49**

Home Automation (X-10) - Connects between a TW523 and your serial port. Receive and transmit all X-10 commands with your home-brewed programs. Full collision detection and auto re-transmission. **\$39**

Caller ID - Decodes the caller ID data and sends it to your serial port in a pre-formatted ascii character string. Example: "12/31 08:45 850-863-5723 Weeder, Terry <CR>". Keep a log of all incoming calls. Block out unwanted callers to your BBS or other modem applications. **\$35**

Touch-Tone Input - Decodes DTMF tones used to dial telephones and sends them to your serial port. Keep a log of all outgoing calls. Use with the Caller ID kit for a complete in/out logging system. Send commands to the Home Automation or Digital I/O kits using a remote telephone. **\$34**

Telephone Call Restrictors

Two modes of operation; either prevent receiving or placing telephone calls (or call prefixes) which have been entered into memory, or prevent those calls (or call prefixes) which have 'not' been entered.

Block out selected outgoing calls. Bypass at any time using your password. **\$35**

Block out selected incoming calls. Calls identified using Caller ID data. **\$48**

Phone Line Transponder

7 individual output pins are controlled with buttons 1-7 on your touch-tone phone. Automatically answers telephone and waits for commands. Monitor room noises with built in mic. "Dial-Out" pin instructs unit to pick up phone and dial user entered number(s). Password protected. **\$49**

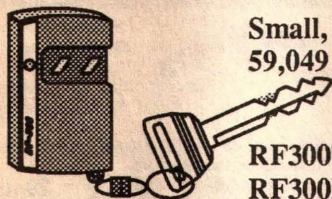
IR Remote Control Receiver

Learns and records the data patterns emitted by standard infrared remote controls used by TVs, VCRs, Stereos, etc. Lets you control all your electronic projects with your TV remote. 7 individual output pins can be assigned to any button on your remote, and can be configured for either "toggle" or "momentary" action. **\$32**

DTMF Decoder/Logger

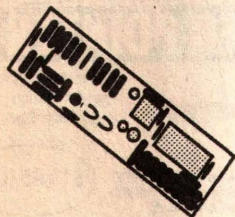
Keep track of all numbers dialed or entered from any phone on your line. Decodes all touch-tones and displays them on a 16 character LCD. Holds the last 240 digits in a non-volatile memory which can be scrolled through. Connect directly to radio receiver's speaker terminals for off-air decoding of repeater codes, or numbers dialed on a radio program. **\$55**

Miniature Transmitters and Receivers



Small, Attractive, High End Quality, 2 Channel 318 MHz Transmitter
59,049 Settable Codes, 120'-300' Range, 1-1/4" x 2" x 9/16", Assembled

	Qty	1	5	10
RF300T 150' Range Transmitter		24.95	19.95	15.95
RF300XT 300' Range Transmitter		29.95	24.95	19.95



Small, High End Quality, 2 Channel Receiver for the RF300 Transmitters
1-1/4" x 3-3/4" x 9/16" PCB w/ .1" spaced pads for standard connectors
Input: 8-24 vdc Output: Gated CMOS Momentary and Latching Lines

	Qty	1	5	10
RF300R Receiver, Fully Assembled		24.95	20.95	16.95
RF300RK Receiver, Complete Parts Kit		19.95	15.95	12.95
RF300PA Pre-Amplifier. Doubles Range		14.95	11.95	9.95



Small, Economical, Single Channel Transmitter and Receiver Set
Set Code, 60' Range, 1-7/8"x2-3/8"x7/16" (T), 2"x2-3/4"x9/16" (R)
Receiver Input: 5 vdc Output: Gated TTL Momentary Line

	Qty	1	5	10
RF60 Transmitter and Receiver Set		24.95	19.95	14.95

Add \$ 4 shipping for first item + \$ 1 for each additional item. Ca. residents add 8.25% tax
Visa, Mastercard, Money Orders Personal Checks and Cash C.O.D.s

Visitect Inc.

P.O. Box 14156 Fremont, CA. 94539 (510) 651-1425 Fax (510) 651-8454

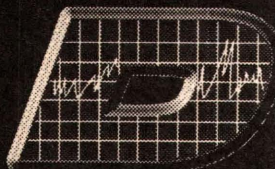
CIRCLE 310 ON FREE INFORMATION CARD

**Quality
Reconditioned**

TEST EQUIPMENT

**WANTED USED
TEST EQUIPMENT**

Visit us at our website
www.danbar.com



**DANBAR
SALES COMPANY**

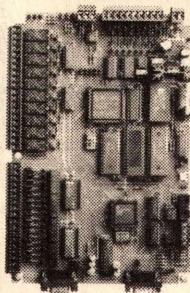
Anritsu ME538M	\$12,500.00	Hewlett-Packard 6920B	\$500.00
EIP 545A	\$1,500.00	Hewlett-Packard 70000 ...	\$22,500.00
EIP 548	\$2,500.00	Hewlett-Packard 8350B ...	\$4,350.00
EIP 548A Opt W36	\$3,900.00	Hewlett-Packard 83592B/002	\$13,900.00
Fluke 87 New	\$275.00	Hewlett-Packard 83594A/002	\$14,700.00
Hewlett-Packard 1650A	\$1,995.00	Hewlett-Packard 8562A ...	\$25,000.00
Hewlett-Packard 1650B	\$2,750.00	Hewlett-Packard 8566B ...	\$39,500.00
Hewlett-Packard 3312A	\$575.00	Hewlett-Packard 8568A ...	\$13,000.00
Hewlett-Packard 3325A	\$2,400.00	Hewlett-Packard 8568B/E96	\$19,750.00
Hewlett-Packard 3336B	\$850.00	Hewlett-Packard 8640B	\$1,250.00
Hewlett-Packard 339A	\$1,250.00	Hewlett-Packard 8656B	\$3,995.00
Hewlett-Packard 355D New ...	\$150.00	Hewlett-Packard 8657A/002	\$3,900.00
Hewlett-Packard 3561A	\$8,250.00	Hewlett-Packard 8662A ...	\$28,700.00
Hewlett-Packard 3561A/001 ...	\$8,750.00	Hewlett-Packard 8901B ...	\$4,250.00
Hewlett-Packard 3562A	\$10,700.00	Hewlett-Packard 8903B ...	\$3,250.00
Hewlett-Packard 3580A	\$900.00	Tektronix 465	\$590.00
Hewlett-Packard 3586B	\$1,000.00	Tektronix 468/02	\$1,150.00
Hewlett-Packard 4274A	\$4,500.00	Tektronix 494P	\$12,500.00
Hewlett-Packard 5342A	\$1,850.00	Tektronix TDS 350	\$2,950.00
Hewlett-Packard 5343A	\$3,950.00	Tektronix THS 710	\$1,295.00
Hewlett-Packard 54501A ...	\$2,750.00	Wavetek 288	\$1,095.00
Hewlett-Packard 54112D ...	\$2,750.00	Wavetek 3520	\$3,250.00

(602) 483-6202 • (602) 483-6403 Fax

14455 North 79th Street, Unit #C • Scottsdale, Arizona 85260

CIRCLE 328 ON FREE INFORMATION CARD

SC552ES CONTROLLER



- 80C552 @ 22MHz
- Enhanced BASIC Language
- 6"x9" circuit board
- 10 5A relay outputs
- 3 LED or logic outputs
- 16 opto-isolated inputs
- 8 ch. 10 bit analog inputs
- 2 ch. 8 bit analog outputs
- Real Time clock/calendar
- 128K Static RAM
- 128K FLASH memory
- 256 byte serial EEPROM
- 3 serial ports (RS232/485)
- IIC bus expansion
- Plug-in I/O terminal blocks
- Single 12Vdc operation

**APPLICATION
READY ONLY**



\$349.95

**SYLVA
CONTROL SYSTEMS**

519 Richard Street, Thunder Bay, Ontario, Canada P7A 1R2
Ph. 807-768-2487 Fax 807-767-0587
www.sylvacontrols.com info@sylvacontrols.com

www.jm-micro.com

PIC In-Circuit Emulator
for the PIC16Cxx from \$295
PIC Programmer \$155
80C552 (8051) Development
Training System \$235
68HC11 SBC \$120
ROMY-16 EPROM Emulator
from \$195

**Universal Microprocessor
Simulator/Debugger (including
Assembler, and Disassembler)**
\$100 each CPU

J&M Microtek, Inc.

83 Seaman Rd, W Orange, NJ 07052
Tel: (973) 325-1892 Fax: (973) 736-4567

LASER MODULE



Auto Power Control
Collimated Laser
Compact Size
100,000 hr lifetime
No Electronics Required

Visible Laser Modules (635-670 nm)
TTL Modulated Laser Modules
Line Generator Laser Modules
Infrared Laser Modules (780-830 nm)

from
\$29 (US)

LASER POINTER



Focus Adjustable
Elegant Design
Solid Metal Body

Pen Style Laser Pointer (1500 ft visibility)
Key Chain Laser Pointer (1500 ft visibility)
Available in silver and, black finish.

\$19.95 (US)

World Star Tech.

Ask for free catalog

Tel: (416) 204-6298 Fax: (416) 596-7819
http://www.worldstartech.com e-mail: info@worldstartech.com

Printed Circuits in Minutes Direct From LaserPrint!

- 8 1/2" x 11"
* Or Photocopy
** Use standard
household iron
or P-n-P Press.

1. LaserPrint*
2. Press On**
3. Peel Off
4. Etch

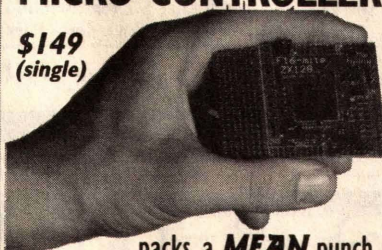


Use Standard Copper Clad Board
20 Shts \$30/ 40 Shts \$50/ 100 Shts \$100
Visa/MC/PO/Ck/MO \$4 S&H

Techniks Inc.
P.O. Box 463
Ringoes NJ 08551
ph. 908.788.8249 fax 908.788.8837
http://chelsea.ios.com/~techniks
Retail Dealer Inquires Invited

FRIENDLY LITTLE MICRO CONTROLLER

**\$149
(single)**



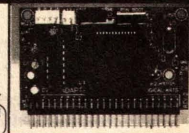
...packs a **MEAN** punch
a.k.a. "Steroid Stamp"

- 39 I/O + 8 A/D (10 bit) •
- 128K SRAM + 128K Flash •
- LCD/Keypad Interface •
- Fast 16 bit Motorola CPU •
- Affordable C Compiler •
- Comprehensive s/w Library •

* **Intec Automation Inc.** v: 250-721-5150
www.steroidmicros.com fx: 250-721-4191

ADAPT-11 68HC11 Modules for Solderless Breadboards

- miniature 2.0" by 2.8" module
- plugs vertically into solderless breadboard for easy development
- BOOT/RUN switch for easy programming via PC serial port
- all I/O lines on dual row connector



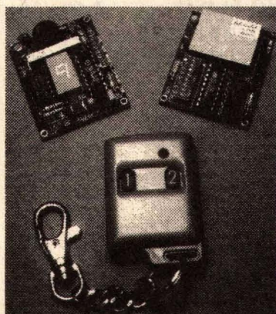
Complete modular prototyping system!
Expansion accessories available!

For just US\$74.95, our Starter Package (AD11SP) provides everything you need to get going fast! Now you can harness the power of the popular 68HC11 in your projects! Includes ADAPT-11 with 68HC11E2, providing 2K EEPROM (re-programmable), 8 channel 8-bit Analog-to-Digital Converter (ADC), hardware timers, counters, interrupts, Serial Peripheral Interface (SPI), Serial Communications Interface (SCI), & more! On-board RS-232 interface (cable included), 5-volt regulator, 8MHz crystal, reset circuit, and convenient program/run switch. Comes with non-commercial versions of 18C11 Assembler, BASIC, & C, as well as handy utilities & example code. Includes Motorola 68HC11 Pocket Programming Reference Guide and manual with schematic. All you need is a PC to write & program your software, a DC power supply, and a solderless breadboard (or protoboard) to build your application circuits on (or use our modular accessories).

Visa • MasterCard • American Express • Discover
TECHNOLOGICAL ARTS
309 Aragona Blvd., Suite 102, Box 418, Va. Beach, VA 23462
1644 Bayview Avenue, Box 1704, Toronto, ON M4G 3C2
voice/fax: (416) 963-8996 www.interlog.com/~techart

RF Wireless Remote Control

- 1,2,3,4 - channel transmitters
- 4-channel superhet receiver module
- LED, relay, and transistor output modules



Intelligent Products

79 Daily Dr. #127, Camarillo, CA 93010
(805) 384-0579 FAX (805) 389-1757

Slot Machines \$ 449.00

Free Shipping

Slot Machine Demo
Video \$ 5.99
40 - Minutes

33" High 20" Wide 14" Deep
Brochure \$ 1.00

Magic Box
Test Chips
Filter Kits

Boop - Boop
Buzz - Buzz

Notch Filters

Video Media www.nutnet.com

P.O. Box 93/6025
Margate, FL 33093
(954)-752-9202



Timid about getting on the... World Wide Web?

You've heard about the *Information Superhighway* and all the hype that goes with it! Sort of makes you feel timid about getting on the Web. Put your fears aside! A new book, *The Internet and World Wide Web Explained*, eliminates all the mystery and presents clear, concise information to build your confidence. The jargon used is explained in simple English. Once the tech-talk is understood, and with an hour or two of Web time under your belt, your friends will believe you are an Internet guru!

To order Book #BP403 send \$10.95 plus \$4.00 for shipping in the U.S. and Canada only to Electronics Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240. Payment in U.S. funds by U.S. bank check or International Money Order. Please allow 6-8 weeks for delivery.

MONDO • TRONICS

ROBOT STORE

* KITS *

Your

* BOOKS *

Mailorder

* PARTS *

Source

* VIDEOS *

For

* MODELS *

Robots!

* MORE! *

(REQUEST OUR FREE CATALOG)

www.robotstore.com

800-374-5764

Or write to us:

4286 Redwood Hwy #226-137
San Rafael CA 94903

Phone 415-491-4600 • Fax 415-491-4696

Email info@mondo.com

PC - Based Test Instruments For Automatic Testing at Bench-Top Prices

- Instrument-on-a-card to plug into PC slot, and turn PC into a test station for automatic testing.
- An operation program included with instrument card, no need for extra software.
- No IEEE488 or RS232 hassle.

100 MHz Dual Universal Counter \$399

6 MHz Function/Sweep Generator \$549

60 MHz Digital Storage Scope \$749

100 MHz Digital Storage Scope \$999

For spec and to download demo : www.tcinst.com

TC INSTRUMENTS INC.®

29 Chaparral Dr., Pomona, CA 91766, USA • Tel: (909) 622-2006 • Fax: (909) 622-7778

COMPLETE INTEGRATED CAD/CAE SYSTEM Schematic, Simulation and Layout

EDWIN NC^{*} Delux 3

- ⇒ Full integration of Schematic and Layout
- ⇒ On-line help
- ⇒ Library viewer with editing possibility
- ⇒ Up to 100 schematics sheets
- ⇒ Up to 32 layers
- ⇒ Automatic DRC with user specified parameters
- ⇒ Automatic component renaming
- ⇒ Mixed-mode simulation (AC, DC and TD analysis)

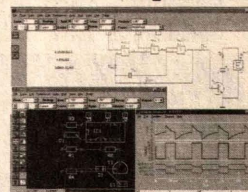
Optionals:

- ⇒ Thermal Analysis for PCI: \$ 29,99
- ⇒ EDSpice Simulator (Spice): \$ 59,99
- ⇒ EDCoMx (Spice model generator): \$ 29,99

FOR
ONLY

\$149.⁹⁹

Windows is registered
trademark of Microsoft Inc.



EDAShop

P.O. Box 55-8207

Miami, Florida 33255-8207

Phone: (305) 267-4005 Fax: (305) 267-0709

Web site: <http://www.edashop.com>

* The "NC" version (Non-Commercial) is destined only for students, hobbyists and educational institutions. Companies must purchase the "Professional" version. However, there aren't any differences between "NC" and "Professional" versions.

EZ-EP DEVICE PROGRAMMER - \$169.95

Check Web!! -- www.m2l.com

Fast - Programs 27C010 in 23 seconds

Portable - Connects to PC Parallel Port

Versatile - Programs 2716-080 plus EE

and Flash (28F, 29C) to 32 pins

Inexpensive - Best for less than \$200

- Correct implementation of manufacturer algorithms for fast, reliable programming.
- Easy to use menu based software has binary editor, read, verify, copy, etc. Free updates via bbs or web page.
- Full over current detection on all device power supplies protects against bad chips and reverse insertion.
- Broad support for additional devices using adapters listed below.

Available Adapters

EP-PIC (16C5x, 61, 62x, 71, 84)	\$49.95
EP-PIC84 (62-5, 72-4)	\$39.95
EP-PIC12 (12C50x)	\$39.95
EP-PIC17 (17C4x)	\$49.95
EP-51 (8751, C51)	\$39.95
EP-11E (68HC11 E/A)	\$59.95
EP-11D (68HC711D3)	\$39.95
EP-16 (16bit 40pin EPROMs)	\$49.95
EP-Z8 (Z86E02, 3, 4, 6, 7, 8)	\$39.95
EP-SEE2 (93x, 24x, 25x, 85x)	\$39.95
EP-750 (87C750, 1, 2)	\$59.95
EP-PEEL (IC22v10, 18v8)	\$59.95
EP-1051 (89C1051, 2051)	\$39.95
EP-PLCC (PLCC EPROMs)	\$49.95
EP-SOIC (SOIC EPROMs)	\$49.95

Many Other Adapters Available

M²L Electronics

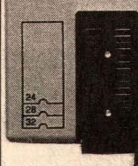
310/837-7818 Fax/BBS: 310/841-6050

3526 Jasmine #4; Los Angeles, CA 90034

CA orders add 8.25% sales tax.

<http://www.m2l.com>

EZ-EP
M²L ELECTRONICS
Los Angeles, California



September 1998, Electronics Now

Cable T.V. Converters & Equipment

Lower
Prices
Dealer
Discounts
30-Day
Money back
1-year
warranty
MC, Visa,
AE, COD



No Florida Sales

www.cable4you.com

1-(800) 888-5585

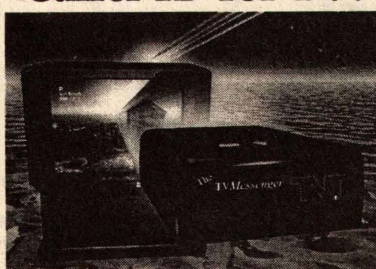
FCC License Preparation

Electronics Tech., Avionics, Marine & Radar
HOMESTUDY—Fast, Easy & Inexpensive
Manuals, Audio, Video, PC disks, latest Q&As
Free 1-800-800-7555 "Guaranteed Pass"
See at <http://www.worldaccessnet.com>
BusinessShowcase/wpt. 4701 NE 47th St.
Vancouver, WA 98661 - WPT Publications

BUGGED??

EAVESDROPPING is unbelievably widespread! Electronic
Devices with amazing capabilities can be monitoring your
telephone and room conversations RIGHT NOW! Are you
sure you're safe? **FREE CATALOG** tells you fast! Includes
Free Bonus details on fantastic opportunities now open in
Counter-Surveillance field. Exciting, immensely interesting
and EXTREMELY profitable (up to \$250 hr) full/part-time
income. Call Now! **1-800-732-5000**

TVMessenger Caller ID for TV!



TVMessenger provides:

- Convenience
- Uninterrupted TV viewing
- Callers' log
- Visual call indicator

- Ease of use
 - Security
- Not available
In stores!

Arrow Technologies

13341 A St., Omaha, NE 68144

1-888-554-2776

only
\$89.95

CLASSIFIED

BUSINESS OPPORTUNITIES

\$400.00 WEEKLY ASSEMBLING electronic circuit boards/products from home. For free information send SASE: **Home Assembly-EN**, Box 216, New Britain, CT 06050-0216.

CABLE TV

CABLE TV SECRETS www.cabletvsecrets.com or \$9.95. Box 527 Pataskala, Oh. 43062.

CONFUSED?? Descramblers. Will explain all your options, all makes and models avl. Dealers are welcome. Open 6 days 9am till 7pm EST, toll free # (888) 238-0967 **ROYAL ENGINEERING INC.** Universal box is here now.

CABLE TV Descramblers. One piece Units. Pioneer, 6310's Scientific, Atlanta 8580's, Dpv's and others. Lowest prices. Money back guarantee. **Precision Electronics**, Houston, TX 1-888-691-4610.

Wholesale and volume pricing. **BOSS** units and **SEEMORES**, compatible with all systems. COD call and compare prices 1-(888) 762-2253.

LOOK no further for converters and accessories. Best picture, Lowest prices. Buy direct and SAVE. **SUPERIOR TECHNOLOGIES** 1-888-922-0671.

BEWILDERED ABOUT DESCRAMBLERS? CALL FOR FAST FRIENDLY EXPLANATION ON YOUR CABLE NEEDS. SAME DAY SHIPPING OR SHIPPING IS FREE. TECH SUPPORT WITH ALL ORDERS. CALL TOLL FREE 1-888-221-8365. GLOBAL ELECTRONICS. M-SAT. 9AM-8PM.

Cable TV Signal Eliminator - Powerful, user tunable filter for removing severe interference OR unwanted channels! Eight models, for channels (2-3)(4-6)(7-13) (14-17)(18-22)(23-29)(30-36)(95-99). Each \$30.00, add \$4.00 for S/H. Quantity discounts. Money back guarantee. Visa, Mastercard or check. COD \$500 extra. Website <http://starcircuits.com/tvfilter>. **Star Circuits**, PO Box 94917, Las Vegas, NV 89193. 1-800-433-6319.

Cable Descramblers and converters. Shop no more. Best prices and tech support. **Extreme Electronics** 1-888-609-4910.

Free Cable Descrambler Plans. For Details Write: Sierra Publishing, 909 E. Yorba Linda Blvd., Suite H-181, Dept. ENS, Placentia, CA 92870.

CABLE test modules/cubes. Pioneers, S/A. Tocoms, Jerrolds, Quantity discounts. Call DCR: Tel: (718) 624-8334 Fax: (718) 246-9731 No NY calls.

UNIVERSAL cable descrambler, 6 month warranty. **GHOST ELECTRONICS** (414) 617-0724. NO Wisconsin Sales.

CABLE TV EQUIPMENT & ACCESSORIES. Wholesalers Welcome! 30 Day Moneyback Guarantee! Free Catalog! **PERFORMANCE ELECTRONICS, INC.** 1-800-815-1512.

NEW! Cellphone E.S.N. readers \$250 each, cell phone programmers \$175 each, cell phones \$25 each, DSS satellite dish card readers and programmers \$125 each, credit card readers \$250 each, Cable T.V. notch filters 50 cents each, convertor boxes \$50 each, magnetic strip card readers for ATM machines, bank cards, drivers license, and all types of data acquisitions all under \$200 each. You pay these super low prices when you deal directly with the manufacturers. When you order "Direct Connection" a 150 page directory published by Ed Treki Publications, you will receive the largest collection of names, addresses, and phone numbers of all the leading American and International manufacturers of these products never before available. Stop paying second, third and fourth hand prices and deal directly with the source!!! Order your copy of "Direct Connection" today for only \$99.95 plus \$5 shipping. All orders are sent C.O.D. Please call Ed Treki Publications 24 hour order hot line 914-544-2829.

CABLE DESCRAMBLING, New secret manual. Build your own Descramblers for Cable and Subscription TV. Instructions, schematics for SSAVI, Gated Sync, Sinewave, \$12.95, \$2.00 postage. **CABLETRONICS**, Box 30502R, Bethesda, MD 20824.

Cablebox descramblers, activators, test chips, low prices. All questions welcome. Toll free (888) 205-6987. M/C/Visa/COD. **E.B. International**.

CB-SCANNERS

CB Radio Modifications! Frequencies, kits, high-performance accessories, books, plans, repairs, amps, 10-Meter conversions. The best since 1976! Catalog \$3.00. **CBCL**, Box 31500EN, Phoenix, AZ 85046.

COMPONENTS

SAVE \$\$\$ Reclaimed electro-mech/electronic components and assemblies. SASE for list. 800/334-1159, **PMA Services**, 22347 La Palma Ave. #106, Yorba Linda, CA 92887.

MISC. ELECTRONICS FOR SALE

PIECE parts for Delco OEM Radio's. Low pricing. Factory original. No subs. Call today, 1-800-433-9657.

FANTASTIC Self running motors, generators and anti-gravity. Free information. **Energy Research**, Box 1514 Jackson, CA 95642.

MISC. ELECTRONICS WANTED

TUBES: "Oldest". "Latest". Parts and schematics. SASE for lists. **Steinmetz Electronics**, 7519 Maplewood Ave., Hammond, Indiana 46324. Phone # 219-931-9316.

PLANS-KITS-SCHEMATICS

ELECTRONIC PROJECT KITS: 49 McMichael St., Kingston, ON., K7M 1M8. \$3.00 catalog. www.qkits.com. **QUALITY KITS**

Eavesdropping Equipment, 117 schematics and text. Free explanation sheet. \$65.00 + S&H \$6.00. Also kit schematics. **Sheffield Electronics**, PO Box 377940, Chicago, IL 60637-7940. (773) 324-2196. <http://www.adnetmk.com/sheffield>.

CATALOG: Broadcasting/micro transmitters, amplifiers, antennas. **Start your own radio station books.** Audio, TV, Ham, CB, Surveillance, Science projects and more. www.panaxis.com **PAN-COM INT'L**, PO Box 130-9, Paradise, CA. 95967.

SECURITY

SECURITY SYSTEMS and surveillance camera equipment. Do it yourself and SAVE. Camera's, Monitor's, VCR's, Motion and Glassbreak Detector's, Control Panel's, Siren's more. www.a1security.com.

TEST EQUIPMENT

TEST EQUIPMENT SALE! Complete listing at <http://www.astglobal.com> or call **NOW** to receive list by fax or mail. **AST GLOBAL ELECTRONICS:** Voice: 888-216-7159, Fax: 814-398-1176; e-mail: sales@astglobal.com.

WANTED

WANTED: USED TEST EQUIPMENT. TURN IDLE OR EXCESS EQUIPMENT INTO CASH. **AST GLOBAL ELECTRONICS:** Voice: 888-216-7159; Fax: 814-398-1176; E-mail: sales@astglobal.com.

SATELLITE EQUIPMENT

FREE CATALOG - Satellite TV/GPS-DIY Technical Books, Installation Videos, Computer Analysis Software. www.baylin.com 800-843-2425.

Satellite Internet 400kbs streaking to you from the sky above! The fastest Internet available nationwide. You must experience it to believe it! Visit our websites: www.ultimate-internet.com or www.invents.net. E-mail: mail@invents.net. **Inventive Solutions Inc.** PO Box 8, Stratford, NY 13470. (315) 429-8782.

DSS Hacking: How to construct and program smart cards, with pic 16C84, PCB layout, Complete DSS system schematics, \$16.95. Software \$25.00. T shirt with "DSS Smart Card" PCB layout on front, \$12.95. **CABLETRONICS**, Box 30502R Bethesda, MD 20824.

SKYVISION! Your Satellite Home Entertainment Source. **Best values:** DBS and C/Ku-band equipment, including 4DTV. Most complete selection: Parts-Tools-Upgrades-Accessories! **Free** Discount Buyer's Guide. Call 800-543-3025. International 218-739-5231. www.skyvision.com.

VIDEO DESCRAMBLERS

BUY WHERE THE DEALERS BUY. GUARANTEED LOWEST PRICE. STARTING AT \$39.99. DESCRAMBLERS FOR ALL SYSTEMS MAKES AND MODELS. DEALERS WELCOMED. QUANTITY DISCOUNTS. CALL NOW 1-800-586-9920.

RADIO TRANSMITTERS

AM Transmitters. FCC certified. Good range 530-1700kHz. Crystal-locked tuning. Chip message storage. 56,000 + sold. www.TalkingHouse.com. 920-922-4800 ext.502

SCRAMBLING NEWS

Pay TV and Satellite Descrambling: 1999 Edition. All the latest cable and satellite fixes. Free catalog. 941-646-2564 or www.scrumblingnews.com.

BEST BY MAIL

Rates: Write National, Box 5, Sarasota, FL 34230

FINANCIAL

CASH NOW FOR FUTURE PAYMENTS! We buy payments from Insurance Settlements, Annuities, and Class Action Awards. We also buy Owner Financed Mortgage Notes. Call R&P Capital at 1-800-338-5815, Ext. ELE500.

OF INTEREST TO ALL

LONG AGO RADIO. Over 7000 old radio programs available on cassette/CD's. Free sample catalog: Toll-Free 1-877-Long-Ago. www.longagoradio.com

EXTRAORDINARY INCOMES - do you want it? We have it! This call can change your life. Not MLM 1-888-310-7301.

Quality Microwave TV Systems

**WIRELESS CABLE - IPTS - MMDS
ATV - INTERNATIONAL - DIGITAL**
Amplifiers • Antennas • Books • Components
• RF Frequency 2100-2700 MHz
• SASE For "FREE" Catalog or Send \$1

PHILLIPS-TECH ELECTRONICS
P.O. Box 18074 • Scottsdale, AZ 85267-3074
CATALOG/INFO: 602-947-7700
ORDER LINE: 800-880-MMDS
FAX LINE: 602-947-7799
WEBSITE: www.phillips-tech.com
E-MAIL: product@phillips-tech.com
Visa • MC • AmEx • Discover • COD's • Quantity Pricing

CHALLENGER SYSTEM
31-Channel Complete \$249
Other Systems Available
3 Year Warranty
FREE SHIPPING

HI-TECH SURVEILLANCE

Pinhole Cameras, Recording Devices, Bug Detectors, Lasers, Lockpicks, Pen Knives, Tracking Devices, Wireless Mics, Books/Videos, plus much more!!!!
FOR CATALOG - SEND \$5.00 TO:

Spy Way
P.O. Box 61805, Jax, FL 32236

Crazy Dan's Price War

"Prices so low you won't believe it"

CABLE DESCRAMBLERS

NOBODY BEATS DAN THE CABLEMAN

1-888-429-4369

CONTROL YOUR WORLD

32K HC11
ModCon
Low Cost Microcontroller boards & kits + Applications
ZORIN <http://ZORINco.com> or call (206) 282-6061

Cable Television

Converters, equipment & test chips

Dealers wanted!!!

Best Prices and Service

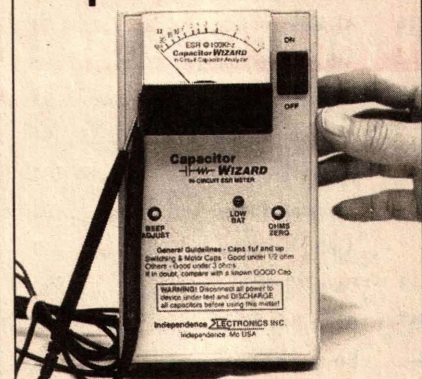
30 Days Money Back

1 Year warranty!

1(800) 660-4180

Find Bad Capacitors

In-Circuit with the Capacitor Wizard



The Capacitor Wizard is an extremely **FAST** and **RELIABLE** device designed to measure ESR (Equivalent Series Resistance) on capacitors of 1uf and larger **"IN CIRCUIT"**, eliminating the need to remove the capacitor for accurate tests. The Capacitor Wizard finds **BAD** caps **IN CIRCUIT** that even **VERY EXPENSIVE** cap checkers **MISS ENTIRELY**, even out of the circuit!! Standard capacitor meters cannot detect any change in ESR therefore they miss bad capacitors leading to time consuming "Tough Dog" repairs. *Technicians say it is the most cost effective instrument on their workbench.*



Made in the USA

Order Today

Only \$179.95

Call 1-800-394-1984

<http://www.heinc.com>

Int. # 316-744-1993

Fax 316-744-1994

6222 N. Oliver, Kechi, KS 67067

30 day money back guarantee

HOWARD HEIN ELECTRONIC INSTRUMENTS INC.
Your Desoldering Specialists

Look What As Little As \$25 A Month Can Get You These Days.

Help with college degrees. Fast cars. A first home. With as little as \$25 a month, a gift of U. S. Savings Bonds can help your kids with all kinds of future needs.

For more information, call toll free:
1-800-4US BOND.

Take Stock in America **U.S. SAVINGS BONDS**
www.savingsbonds.gov

ADVERTISING INDEX

Electronics Now does not assume any responsibility for errors that may appear in the index below.

Free Information Number	Page	Free Information Number	Page
— Abacom Technology	95	— Jameco	CV3
— ABC Electronics	74	— James Electronics	74
— AES	100	330 Link Instruments	90
213 Alfa Electronics	88	— Lynxmotion	94
214 All Electronics	83	— M ² L Electronics	103
— Allison Technology	85	325 Mark V Electronics	98
282 American Eagle Publications	95	327 MCM Electronics	5
— Andromeda Research	91	251 Mendelson Electronics Surplus	86
— Arrow Technologies	86, 104	324 Merrimack Valley Systems	91
— Associated Electrical & Eng.	100	133 MicroCode Engineering	CV2
— Audio Amateur	79	— microEngineering Labs	94
313 Basic Electrical Supply	80	— Micro Test	94
337 Beige Bag	82	— Midwest Laser Products	85
— Bossman Electronics	78	— Modern Electronics	84
322 C&S Sales, Inc.	76	— Mondo-tronics	103
— Cable USA	84	318 Mouser Electronics	84
332 Circuit Specialists	96	271 Netcom	75
— CLAGGK, Inc.	13, 68	— NRI Schools	29
— Cleveland Inst. of Electronics	21	— NYE Electronics	94
— Command Productions	81	— PC Boards	70
— Computer Monitor Maintenance	74	— Pioneer Hill Software	91
226 Consumertronics	80	— Point Six	92
228 Cool Amp Conducto Lube	81	217 Polaris Industries	82
234 Dalbani Electronics	71	215 Prairie Digital	75
235 Danbar Sales	101	264 Print (Pace)	73
312 Dynamic Technology	99	78 Radio Shack	3
— EDASHOP	103	266 Ramsey Electronics	72
— EDE - Spy Outlet	88	334 Roger's Systems Specialist	93
— Electronic Tech. Today	69	— SE International	78
— Emac Inc.	94	— Sil Walker	88
— Fair Radio	85	— Square 1 Electronics	70
335 Foley-Belsaw	89	— Tab Books	59
— General Device Instruments	92	— TC Instruments	103
122 Global Specialties	7	311 Telulex	79
— Grantham Col. of Engineering	4	333 Test Equipment Depot	70
329 Graymark International	84	328 Test Equipment Sales	78
— Home Automation	92	275 Timeline	95
331 Howard Electronics	87	— U.S. Cyberlab	92
— Howard Electronics	105	310 Visitect Inc.	101
— Information Unlimited	86	— Visual Communications	4
126 Interactive Image Technologies	CV4	— Weeder Technologies	100
— Intronics, Inc.	91	272 White Star Electronics	75
— IVEX Design International	91	— World College	41

ADVERTISING SALES OFFICES

Gernsback Publications, Inc.
500 Bi-County Blvd.
Farmingdale, NY 11735-3931
1-(516) 293-3000
Fax 1-(516) 293-3115

Larry Steckler
 publisher (ext. 201)
 e-mail advertising@gernsback.com

Adria Coren
 vice-president (ext. 208)

Ken Coren
 vice-president (ext. 267)

Christina Estrada
 assistant to the publisher (ext. 209)

Arline Fishman
 advertising director (ext. 206)

Marie Falcon
 advertising assistant (ext. 211)

Adria Coren
 credit manager (ext. 208)

For Advertising ONLY EAST/SOUTHEAST

Megan Mitchell
 9072 Lawton Pine Avenue
 Las Vegas, NV 89129
 Phone 702-240-0184
 Fax 702-838-6924
Lorri88@aol.com

MIDWEST/Texas/Arkansas/Okla.
Ralph Bergen
 Midwest Advertising
 One Northfield Plaza, Suite 300
 Northfield, IL 60093-1214
 1-847-559-0555
 Fax 1-847-559-0562
bergenrj@aol.com

PACIFIC COAST

Janice Woods
 Pacific Advertising
 Hutch Looney & Associates, Inc.
 6310 San Vicente Blvd., Suite 360
 Los Angeles, CA 90048-5426
 1-213-931-3444 (ext. 228)
 Fax 1-213-931-7309
janice@hlooney.com

Electronic Shopper
Joe Shere
 National Representative
 P.O. Box 169
 Idyllwild, CA 92549-0169
 1-909-659-9743
 Fax 1-909-659-2469
Jshere@gernsback.com

Megan Mitchell
 National Representative
 9072 Lawton Pine Avenue
 Las Vegas, NV 89129
 Phone 702-240-0184
 Fax 702-838-6924
Lorri88@aol.com

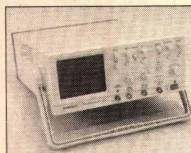
Customer Service
 1-800-999-7139
 7:00 AM - 6:00 PM M-F MST



Test Equipment

20MHz Dual Trace Oscilloscope

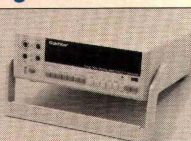
- 6" rectangular high resolution blue CRT with internal graticule & scale
- Power requirements: 98-125VAC @ 1A, 198-255VAC @ 0.5A, 50/60Hz, 45W



Part No.	Product No.	Description	Price
136098	OS5020	20MHz scope	\$399.95

Benchtop Digital Multimeter

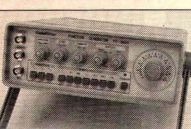
- 4 1/2 digit display, 5-digit green LED, 19999 count
- True RMS in AC range
- Data hold, diode check, transistor hfe measurement available



Part No.	Product No.	Description	Price
132564	DM441	Multimeter	\$229.95

2MHz Function Generator

- Frequency range: .02Hz to 2MHz
- Waveforms: sine, triangle, square, ramp, TTL pulse, skewed sine
- Variable waveform/duty cycle symmetry
- Linear sweep control from: 1:1 to 100:1



Part No.	Product No.	Description	Price
66069	FG8002	Function gen.	\$199.95

2MHz Sweep Function Generator with 4-Digit Green LED Frequency Counter

- General specifications same as FG-8002 (above)
- Counter: frequency range: 2Hz to 2MHz (Ext. 4MHz)
- Maximum input voltage: 150 VRMS at 1kHz



Part No.	Product No.	Description	Price
94676	FG7002C	Function gen.	\$319.95

Digital and Analog DC Power Supplies

- 30VDC @ 3 Amps
- Can be used for positive or negative source



Part No.	Description	Wt. (lbs.)	Price
101928	Analog DC	10.9	\$189.95
121152	Digital DC	10.7	199.95



Soldering Equipment

Digital Display Soldering Station

- Electronic temperature control from 200°F to 878°F
- UL listed
- Includes tip



Part No.	Product No.	Price
35351	XY960	\$129.95

Analog Display Soldering Station

- Temperature: 300°F to 850°F
- Protects against voltage spikes



Part No.	Product No.	Price
114569	XY1683C	\$89.95

Combo Soldering/Desoldering Station and Desoldering Station

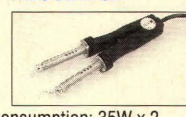
- XY968D: Digital Fahrenheit/Centigrade read out
- XY968D/XY999SDA: AntiClog/Energy Saver
- Vacuum pump activated "on demand" using finger tip switch on desolder handle
- Spike control feature



Part No.	Product No.	Wt. (lbs.)	Price
125508	XY960	13.1	\$349.95
125516	XY999SDA	18.1	\$449.95

SMD Tweez Iron

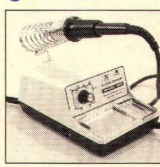
- Maximum efficiency ceramic heating elements
- 120VAC
- Heater power consumption: 35W x 2
- Max. temp.: 760°F • UL approved



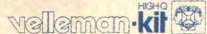
Part No.	Product No.	Wt. (lbs.)	Price
137031	TW2226	1.0	\$69.95

Electronic Temp-Control Soldering Station

- Temperature control: 500°-800°F
- Protects from voltage spikes
- Power: 45W at 650°F • UL listed
- Includes tip



Part No.	Product No.	Price
129058	XY369	\$59.95



Flashing LED Sweetheart Kit

Shows a beating heart!

- Operating voltage: 8 to 15VDC
- Power consumption: 8mA
- Size: 2.5"L x 2.4"W x 1.2"H



Part No.	Description	1-9	10-24
147555	MK101 mini kit	\$11.95	\$10.95

Universal Battery Charger/Discharger

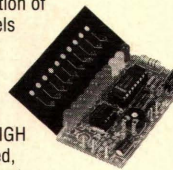
- Charges current from 15mA to 750mA selectable
- Charges both Ni-MH and Ni-Cad batteries
- Usable battery voltage: 1.2/2.8/3.6/4.8/6.0/7.2/8.4/9.6VDC



Part No.	Description	1-9	10-24
147598	K7300 bat. charger	\$19.95	\$17.95

10 LED Mono VU Meter Kit

- Instant visualization of audio signal levels
- Easy hook up to a LINE level (LOW input) signal source
- Special input (HIGH input) is provided, which allows direct connection to a speaker output
- Frequency range: 20Hz to 30kHz



Part No.	Description	1-9	10-24
147643	K4304 VU meter	\$16.95	\$14.95

Flashing LED Kit

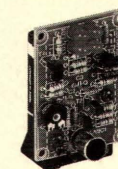
- For applications such as model constructions. Adjustable flashing speed by potentiometers.
- Operating voltage: 9VDC



Part No.	Description	1-9	10-24
147580	MK102 mini kit	\$6.95	\$6.25

Voice Activated Kit

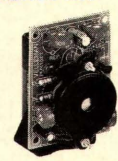
- Uses sound to activate the flashing of 4 bright LEDs.
- Adjustable sensitivity
- Operating voltage: 8-15VDC



Part No.	Description	1-9	10-24
147571	MK103 mini kit	\$10.95	\$9.95

Electronic Cricket Kit

- Sounds like a cricket when it gets dark!
- Operating voltage: 8-15VDC
- Adjustable cricket effect, tone and light sensitivity



Part No.	Description	1-9	10-24
147547	MK104 mini kit	\$14.95	\$13.49

Values & Bargains

Pentium® 133MHz Desktop System

- 16MB of RAM expandable to 128MB
- 256KB cache RAM
- 3.5" floppy drive, 1GB hard drive and 8X CD-ROM
- Combination sound and modem card
- 2MB VGA graphics card on board upgradeable to 4MB
- Windows® 95, MS Money, MS Works
- Includes 104-key keyboard, remote control (mouse), 3.5" software and drivers and manual
- Size: 16.5"L x 16.0"W x 5.0"H
- Weight: 29.4 lbs.

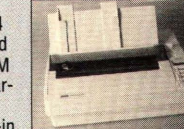


Monitor not included

Part No.	Description	Price
152338	133MHz Pentium® System	\$589.95

DEC Writer 95 Printer

- Windows® 95 Compatible
- Impact dot-matrix with 24 wire print head
- Epson and IBM emulation character set
- 13 fonts built-in
- Includes sheet feeder, manual and drivers (Windows® 3.1 & 95)
- Weight: 14.0 lbs.
- Size: 15.9"W x 12.6"D x 5.4"H



Part No.	Description	Price
151618	DEC writer 95	\$74.95

486 Motherboard

- Socket type 3
- Award BIOS
- Supports 25-133MHz; 486SX/DX/DX2/DX4 CPUs
- Three PCI and 3 ISA slots
- 128KB cache on board, expandable to 256KB
- Built-in I/O controller supports two IDE connectors (4 devices), FDD, 2 serial ports, 1 parallel port (SPP/EPP/ECP) mode



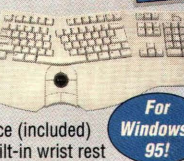
Part No.	Description	Price
151870	486 MB w/o CPU	\$89.95

Part No.	Description	Price
153031	Pentium MB w/o CPU	\$59.95

Part No.	Description	Price
151781	386 MB w/ CPU	\$49.95

104-Key Ergonomic Keyboard with Trackball

- Inter-changeable pointing device from trackball to solid surface (included)
- Extra wide built-in wrist rest



Part No.	Description	Price
149972	Ergonomic keyboard	\$49.95



Order Toll Free 24-Hours
7-Days a Week!

© 1998 Jameco 9/98



Mention
VIP #
9R8

Call 1-800-831-4242 day or night!

Mail or Fax Us to Receive Our Free 983 Jameco Catalog!



Name: _____
Company: _____
Address: _____
City: _____ State/Zip: _____
Phone#: () _____

VIP 9R8

Better Designs - Faster

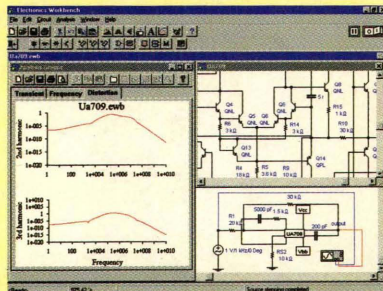
With the Personal Design Solution

The Design Solution Includes: Electronics Workbench Personal Edition + EWB Layout

Electronics
Workbench
Personal Edition

Full-featured schematic capture and SPICE 3F circuit simulation!

The world's best selling circuit design software. With analog, digital and mixed A/D SPICE simulation, a full suite of analyses and over 4000 devices. Imports netlists. Seamlessly integrated with EWB Layout or exports to other popular PCB programs. Still the standard for power and ease of use. Still the same effective price.



\$299
Version 5

HIGH-END FEATURES

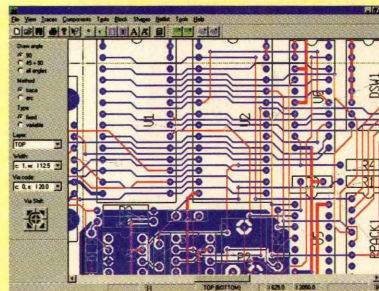
TRUE MIXED ANALOG/DIGITAL	YES
FULLY INTERACTIVE SIMULATION	YES
PRO SCHEMATIC EDITOR	YES
HIERARCHICAL CIRCUITS	YES
VIRTUAL INSTRUMENTS	YES
ON-SCREEN GRAPHS	YES
ANALOG AND DIGITAL MODELS	OVER 4,000
FREE TECHNICAL SUPPORT	YES
DC OPERATING POINT	YES
AC FREQUENCY	YES
TRANSIENT	YES
FOURIER	YES
NOISE	YES
DISTORTION	YES

**30-DAY MONEY-BACK
GUARANTEE**

Electronics
Workbench **Layout**
Personal Edition

Power-packed PCB layout with autorouting and real-time DRC!

EWB Layout is a powerful board layout package for producing high-quality, multi-layer printed circuit boards. Offering tight integration with our schematic capture program, you can incorporate board layout and design and quickly bring well-designed boards to production.



\$299
Version 5

POWER-PACKED FEATURES

AUTOROUTING	YES
REROUTE WHILE MOVE	YES
LAYERS	32 ROUTING LAYERS
BOARD SIZE	50" X 50"
LIBRARY SHAPES	OVER 3,500
BLIND AND BURIED VIAS	YES
EXTENSIVE OUTPUT	YES
SELECTIVE NET HIGHLIGHTING	YES
USER DEFINED PADS	YES
REAL TIME DESIGN RULE CHECK	YES
DENSITY HISTOGRAMS	YES
FREE TECHNICAL SUPPORT	YES

*Join over 85,000 customers
and find out why more circuit designers
buy Electronics Workbench than
any other circuit design tool.*

**CALL FOR INFORMATION
AND PRICING ON OUR
PROFESSIONAL EDITION.**

ELECTRONICS WORKBENCH Personal Edition	\$299.00
EWB LAYOUT Personal Edition	\$299.00

**BUY
BOTH
AND
SAVE**

PERSONAL DESIGN SOLUTION	~~\$598.00~~ \$548.00
--------------------------	---------------------------------

CALL 800-263-5552

For a free demo, visit our website
at <http://www.interactiv.com>

INTERACTIVE IMAGE TECHNOLOGIES LTD., 908 Niagara Falls Boulevard,
#068, North Tonawanda, New York 14120-2060 / Telephone 416-977-5550.
TRADEMARKS ARE PROPERTY OF THEIR RESPECTIVE HOLDERS. OFFER IS IN U.S. DOLLARS AND VALID ONLY
IN THE UNITED STATES AND CANADA. ALL ORDERS SUBJECT TO \$15 SHIPPING AND HANDLING CHARGE.

Fax: 416-977-1818 E-mail: ewb@interactiv.com
CompuServe: 71333,3435 / BBS:416-977-3540

